Journal of Food Chemistry & Nanotechnology

https://doi.org/10.17756/jfcn.2021-suppl1

Meeting Abstracts

Open Access

Proceedings of the Seventh International Conference on Food Chemistry & Technology (FCT-2021)

Session I – Food Chemistry

From Molecular Assemblies to Nutritional Food Products

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Abstract:

Food products combine a variety of molecular architectures and physical phases leading to the formation of unique structures responsible for specific textures and mouthfeel. The food texture is mainly controlled by the molecular assemblies on a different length scales from the molecular interactions and structural assembly to the bulk network arrangement. These structures can be harnessed to improve food nutritional value by replacing harmful ingredients, such as saturated fat, while maintaining preferable textural attributes and consumer experience. The talk will focus on the development, characterization and utilization of structuring methods to form new food systems with unique nutritional and textural attributes. More specifically, the use of oil and water structuring approaches with proteins, polysaccharides, and low molecular weight oil gelators to formulate bigel system will be presented. The effect of various preparation conditions will be presented with respect to stability and hardness where a significant impact was related to the structuring agent concentration and the homogenization time. Bigel structural, thermal and rheological properties was examined using different emulsifiers with different HLB value in order to evaluate the role of each component on the final gel functionality. The results demonstrate the importance of the interface content in O/W bigel systems, providing an effective way to alter and control the bigel's bulk properties. Overall, bigel systems can enrich the nutritional profile of high saturated fat materials aiming to improve the consumer health and wellbeing, while maintaining consumption experience.

Novel Regioselective Synthesis of Urolithin Glucuronides, Human Gut Microbiota Metabolites of Food Ellagitannins and Ellagic Acid

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Abstract:

Urolithins (dibenzo-pyran-b.d-6 one derivatives) are gut microbiota metabolites produced from ellagic acid and ellagitannins that are present in relevant amounts in foods, including pomegranates, berries (strawberry, raspberry, blackberry), nuts (walnuts, pecans), tropical fruits (camu-camu, jaboticaba), oak-aged wines and spirits, and many herbal medicinal products. Urolithins are better absorbed than ellagic acid and show relevant health effects and biological activities that suggest that they are responsible for the health effects observed after the intake of these foods. In the systemic circulation, urolithins occur as glucuronide conjugates due to Phase II metabolism to enhance their solubility and urinary excretion. Thus, these phase II conjugates are essential metabolites to test the biological

effects of urolithins on in vitro human cell line models. Urolithin glucuronides are not commercially available, and their biosynthesis leads to mixtures of both regional isomers of urolithin A and isourolithin A. In fact, only the synthesis of urolithin B-glucuronide has been reported. Urolithin aglycones have been chemically synthesized by different methods. However, the synthesis of the primary circulating glucuronide metabolites has not been reported, probably due to difficulties to produce and isolate each of the two isomers of urolithin A [urolithin A 3-glucuronide (8-hydroxy urolithin 3-glucuronide) and urolithin A 8-glucuronide (3-hydroxy urolithin 8-glucuronide)] and isourolithin A [isourolithin A 3-glucuronide (9-hydroxy urolithin 3-glucuronide) and isourolithin A 9-glucuronide (3-hydroxy urolithin 9-glucuronide)]. These different glucuronides can probably exert distinct biological effects or being produced in different quantities depending on the individuals due to different enzyme polymorphisms. However, this has not been demonstrated yet due to the lack of authentic standards of these metabolites. This study describes a novel and regioselective synthesis of Urolithin A, 3- and 8- glucuronides and Isourolithin A, 3- and 9- glucuronides, and their identification by 1H NMR, HRMS, and UV spectrophotometry. The occurrence of the metabolites in different volunteers will also be assessed.

Pickering Emulsions and Janus Particles for Food and Agriculture

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Abstract:

Pickering emulsions are emulsions of any type, for example oil-in-water (o/w) or water-in-oil (w/o), stabilized by solid particles instead of surfactants. In comparison to surfactant-based emulsions, Pickering emulsions show improved stability, low toxicity, adjustable permeability, and diverse functionality according to a variety of particles available, thus making the emulsions suitable for many applications in biomedical and food sciences. In this research, we have developed Pickering emulsions that are stabilized by functionalized silica nanoparticles, and have implemented them toward challenges in the field of food and agriculture. We present a highly tunable and biocompatible biopesticide formulation, based on a single cell microencapsulation of the conidia enthomopathogenic fungus Metarhizium brunneum in an o/w silica-stabilized Pickering emulsion. The Pickering emulsion-based formulation exhibited significantly higher pest control activity against Spodoptera littoralis larvae compared to the control systems, thus making it a promising, cost effective, innovative approach to tackling the arthropod pest control challenge in agriculture. Another approach to prepare stable, homogeneous oil-in-water (o/w) Pickering emulsions is by in situ functionalization of silica nanoparticles by two organosilanes with opposite polarities, leading to the formation of silica-based colloidosomes. The introduction of carbon nanotubes (CNT) to the silica based Pickering emulsion enabled us to prepare electrically conductive CNT/silica colloidosomes with controlled porosity and electrical conductivity. CNTs and silica nanoparticles both are located in the interface, as evidenced by confocal laser scanning microscopy and cryo-SEM. In addition, we have developed a new superhydrophobic coatings based on a silica-stabilized oil-in-oil Pickering emulsion system. The application of the emulsions on a given surface, along with a rapid drying process results in the formation of unique silica-based shells-like structures which demonstrates a combination of micro- and nanoscale roughness, resulting in a durable and transparent superhydrophobic surfaces. The coating compositions can be tuned to meet the demands and the requirements of the food industry in terms of costs and regulation.

Identification of Bioactive Lipophenols in Olive Oil

Pierluigi Plastina

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Abstract:

Health benefits deriving from the consumption of extra virgin olive oil (EVOO) are associated with the presence of phenolic compounds. Among these, tyrosol and hydroxytyrosol are the major simple phenolics found in olive and EVOO. They are present in their esterified forms, mainly as secoiridoid derivatives (ligstroside and oleuropein,

respectively) as well as in their free form. Recently, we identified hydroxytyrosyl oleate (HtyOle) as a novel lipophilic derivative in olive oil and by-products. Moreover, HtyOle displayed anti-inflammatory, antioxidant and tissue regenerating properties in in vitro cell models. This compound is a member of lipophenols, an emerging subclass of phenolic compounds structurally characterized by the presence of a lipid moiety. Their lipophilicity allows them a higher adsorption and bioavailability with respect to polar phenolics. In this lecture, the most up-to-date research studies in the area of olive lipophenols will be discussed.

NMR-Based Metabolomic Approach to Study Olive Oils

Luisa Mannina

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Abstract:

The ability of NMR spectroscopy to solve spectra of complex mixtures and to recognize and quantify each component without chemical separation, has found a constantly increasing application in metabolomics and food chemistry. As a non-specific high-throughput analytical method, NMR spectroscopy is well suited to the requirements of metabolite profiling having the advantage to detect signals due to many different classes of compounds in the same experiment. In this presentation I will highlight the milestones of the history between the Nuclear Magnetic Resonance spectroscopy and olive oil. The story was born in the first years of the 1990th and goes on giving relevant results on olive oils authentication, geographical origin, variety, quality, etc. This methodology together with other classical analyses can provide an answer to the current problem of the "protection" of high-quality olive oils.

Novel Method Based-on Oxidase-like Nanozyme for Total Antioxidant Capacity Assay of Fruit and vegetable Food

Wentao Zhang

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Abstract:

The total antioxidant capacity (TAC) has become increasingly important for evaluating antioxidant food quality in healthcare. Therefore, it's essential to construct a reliable strategy towards TAC assay. Herein, a 2D Fe-Mn Bimetallic nanozyme modified with dextran (Dex-FeMnzyme) was exploited for TAC colorimetric assay. Dex-FeMnzyme exhibits superior oxidase-like activity on rapidly catalyzing colorless 3,3,5,5-tetramethylbenzidine (TMB) to generate blue oxidized TMB (oxTMB) without H2O2. Due to the reducibility of antioxidants existed in food, the blue Dex-FeMnzyme/oxTMB system can be availably weakened. According to the difference in color, we designed a high-sensitivity colorimetric sensor for TAC assay taking ascorbic acid (AA) as a typical model. Moreover, the colorimetric sensor was applied to determine TAC content of beverage, Kiwi fruit and tomato, demonstrating the feasibility of practical application in real samples. The study offered a new avenue for developing high-activity bimetallic nanozymes and colorimetric biosensors.

Cleaner and Sustainable Production of Biobased Surfactants using Ion-Exchange Resin Catalyst

Naomi Shibasaki-Kitakawa

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Abstract:

Biobased surfactants, such as esters of sugars and fatty acids, are safe and can be used in a wide range of applications

from aqueous solutions to oil-based systems, depending on the chain length of the fatty acid. Industrially, however, these surfactants are produced using homogeneous alkali catalysts under severe conditions of high temperature and reduced pressure. As a result, the catalyst reacts with the fatty acids to form soap and the fatty acids with short chain lengths, which tend to evaporate, cannot be used. We have found a new synthesis method using an anion-exchange resin as a catalyst under mild conditions (60°C, atmospheric pressure) and developed an efficient continuous production process of sugar esters. This allowed the continuous production of new sugar esters with a carbon chain length of 8 in a yield of more than 60% in a residence time of only 8 minutes. It was also found that even crude sugar with impurities can be used as a raw material as well as refined sugar used in the industrial production. Experiments were carried out in column reactors of various sizes to determine the productivity per resin volume per hour, and it was found that a good scale-up was possible by keeping the residence time constant. In this system, no soap was formed and the sugar esters were easily purified from the effluent. The purity of the purified product was 97%, the hydrophilic-lipophilic balance (HLB) value was about 17, and it was found to have antibacterial properties.

High Throughput Method for Quantifying Androstenone and Skatole in Adipose Tissue from Uncastrated Male Pigs by Laser Diode Thermal Desorption-Tandem Mass Spectrometry

Birgitte Winther Lund

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Abstract:

There is a strong and increasing opposition towards the castration of male piglets from, among others, several animal welfare NGOs. A Brussels Declaration calling for a voluntary ban on the surgical castration of pigs without sedation in Europe by 2018 has been signed by several representatives of the pig meat value chain in EU member states. However, a major challenge related to the production of meat from uncastrated male pigs is the risk of tainted meat. A variable percentage of the entire males develop boar taint, a flavour that is generally undesirable and unacceptable by some consumers. There is a general understanding that boar taint is predominantly caused by the compounds skatole and androstenone. A rapid and robust mass spectrometric method has been developed, capable of measuring the malodorous compounds androstenone and skatole in back fat samples from male pig carcasses. The analytical method can be used in abattoirs as an at-line method to quantify the boar taint compounds in carcasses or as a high-speed analysis in laboratories with high sample turnover. The chemical assay is based on salt-assisted liquid-liquid extraction and direct measurement with Laser Diode Thermal Desorption-Tandem Mass Spectrometry (LDTD-MS/MS). When fully automated as an at-line method, a single LDTD-MS/MS system will have a measuring capacity of more than 420 male pig carcasses per hour. The limit of quantification (LOQ) is 0.05 µg/g and 0.10 µg/g for skatole and androstenone, respectively, which is well below the expected sorting thresholds and the reproducibility of the method (%RSD) is below 10%.

Efficient and Sustainable Extraction of Marine Collagens from Starfish Using High Shear Homogenization and Ultrasound

Naveen Kumar Vate

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Abstract:

Marine resources have gained great interest as more sustainable and safe sources of collagen compared with the mammal sources. However, commonly used collagen extraction processes suffer from unsustainability and low efficiency requiring large amount of chemicals as well as complicated and very time-consuming pretreatment and extraction steps. Within the frame of the BlueCC project, the efficiency of high shear mechanical homogenization (HSMH) and ultrasonication in reducing extraction time and required amount of solvent during the pretreatment

steps of native collagen extraction from common starfish (Asterias rubens) was investigated. The common starfish is obtained as a by-catch during mussel harvesting which can be an interesting source for extraction of collagen. Results showed that the time required for the deproteinization pretreatment was substantially reduced from 6 h to 30 min using the HSMH at 4000 rpm for 2.5 min compared to the classic method. With the aid of HSMH, the replacement of alkaline solution could be also skipped and the raw material to alkaline solution ratio was reduced to 1:10 compared to 1:20 in the classic method. The demineralization time was also reduced by half from 48 h to 24 h with one change of EDTA solution at 12 h. Ultrasound in combination with HSMH could also improve demineralization pretreatment efficiency. The yield of collagen also substantially increased with application of HSMH and ultrasound compared to the traditional method. The impacts of modification on the structural and functional properties of the extracted collagen will be also presented.

Active Polymeric Sheets for Plant Protection based on Pickering Emulsion Templating

Karthik Ananth Mani

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Abstract:

In the past few years, there has been a tremendous amount of scientific activity in the field of controlled release of volatile antimicrobial agents such as Thymol and Carvacrol, which have shown high antimicrobial activity and suitability for food and agriculture applications from the regulatory point of view. However, the ability to develop efficient and cost effective controlled release formulations for essential oils is still highly challenging. This research presents the development of active polymeric sheet for plant protection. Thymol is a natural monoterpenoid phenol, which is isomeric with Carvacrol found in thyme oil and has beneficial properties. Thymol will be dissolved and encapsulated in the minor phase of toluene-in-water Pickering emulsion or in the major phase of an inverse emulsion. Polycaprolactone or polydimethylsiloxane will be dissolved in the toluene phase. The studied emulsions with the encapsulated Thymol will be impregnated in a non-woven polypropylene sheet. After evaporation of the water and toluene, polymeric structures with Thymol in their matrix will be formed inside the non-woven sheet. The activity of the resulting sheets along with their release properties will be compressively investigated for protecting these plants; rosemary, mint, and thyme through bioassay infectivity analysis. The system, which will be developed in this proposed research, is expected to exhibit high tunability in terms of the release rates and clear ability to encapsulate known amounts of Thymol in the resulting capsule. In addition, this Pickering emulsion-based formulation has shown clear feasibility to be impregnated in polypropylene non-woven sheet, which results in the formation of active silica/polymer microspheres on the filaments of the sheet.

The Interference of Dietary Fibre with Lipolysis Depends on the Type of Administration of B-Glucans by Means of Different Solubilisation Processes

Kathrin Haider

Quadram Institute Bioscience, United Kingdom

Abstract:

Introduction: Human studies show that sufficient dietary fibre (DF) intake helps maintain a healthy body weight [Chambers 2015], irrespective of calorie restriction [Jovanovski et al. 2020]. One potential underpinning mechanism is reduced lipid digestion from foods, which is hypothesised to depend on the DF composition, structure and physico-chemical properties including means of solubilisation of β-glucan (BG).

Methods: Barley and oat bran fibre ingredients, as well as extracts thereof, with different physico-chemical properties including BG content and molecular size were digested together with an O/W emulsion in vitro under simulated gastric conditions (pH 3, 37^{0}C, 2h). This was followed by digestion using duodenal conditions in a pH-stat (pH 7, 37^{0}C, 2h) where bovine bile extract (10 mM final concentration) was added. Additionally, a lipase activity

assay investigated the interference with lipolysis of tributyrin without the presence of bile salts. Viscosity and other physico-chemical properties were measured.

Results: Barley bran and its extracted BG appear more potent in delaying lipolysis than oat bran and its BG extracts, despite our recent results showing oat bran retains more bile salts. Insoluble fibre plays a role in the solubilisation of BG. A viscosity effect was observed at the higher oat bran concentrations. The lipase activity was reduced by both barley and oat bran in absence of bile salts.

Conclusion: Cereal DF has the potential to slow down lipid digestion via increased viscosity, bile salt and/or lipase interaction. Insoluble DF seems to play a role in the solubilisation and consequential effects of the soluble fibre BG.

Protein Extraction from BSF Flour, Analysis of Composition and Protein Profile

Lucas Sales Queiroz

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Abstract:

Edible insects have been considered as a sustainable and promising food protein source and they have demonstrated a wide range of functional properties. Among the most promising edible insects Black Soldier Fly (BSF), Hermetia illucens, has gained more attention due to its good protein content, amino acid composition and capacity to feed from organic waste and protein conversion. Herein we compared the flour and protein extract composition based on their moisture, ash, amino acids, mineral and protein content. To have a deeper knowledge on protein profile and behavior SDS-page electrophoresis and some analytical analyzes were stablished. Fourier transform infrared spectroscopy (FTIR) and differential scanning calorimetry (DSC) were used to give information about protein structure and thermal stability under temperature range, respectively. After protein extraction the product contained 64% of protein. The flour and the protein extract contain all EAA, except for Tryptophan. The EAA composition meets the requirement of the WHO. DSC graph reported a glass transition temperature around 30°C, recognizable by a shift in the curve, and a big endothermic peak for solid melting at around 200°C. FTIR analysis showed the main Amide bands (A, B, I, II, III) for flour and protein extract, used in proteins for structure characterization. BSF is a great source of mineral and amino acids and its proteins revealed a promising techno-functional application, considering protein profile and stability for further food formulation development.

The Understanding of Sensory Descriptors of Wine by Australian-Italian and Vietnamese Non-Expert Consumers

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University of Verona, Italy

Abstract:

Wine is the one of the most interesting consumable subject in the world (Wagner, 2013). The study of food sciences has drawn much attention to cross-cultural relations in wine appreciation, wine tasting and wine descriptions (Saenz-Navajas, 2014; Yoo, 2013; Rodrigues, 2019) used by international marketers when an international projection of wine is presented. The studies aim to, in a cross-cultural perspective, whether opposites are useful to investigate non-experts' comprehension of terms frequently used to describe the sensorial properties of wine. The study focused on a selection of 64 temrs frequently used to describe the characteristics of wine in the text of Product Specifications. These studies started from an initital study (Bianchi, Branchini, Torquati, Fermanin, Capitani, Barnarba, Savardi and Burro, 2021) and then tested whether significant difference emerged in the finding emerging when the same task was asked to a sample of Australian non-expert wine consumers (Study 2) and a sample of Vietnamese non-expert wine consumers (Study 3), (Truong, H., Burro, R., & Bianchi, I., 2021). One of the main findings emerging from all three studies is that the majority of participants (more than 80%) were able to think of the sensorial properties of

wine in terms of opposites. The Italian participants were able to establish a richer set of alternative opposites for red wine than the Vietnamese participants. Australians are generally in an in-between position.

Optimization of Volatile Compounds Extraction and Evaluation of the Antioxidant Activity Potential of Pineapple and Celery By-Products

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Abstract:

The production of a huge amount of agricultural residues, also called agro-wastes is an issue in many countries all around the world, particularly in those where the environmental concerns have been raised in the last few years. This lack of utilization results in missing important opportunities to valorize and further reduce the environmental impact of biobased industries. The aim of the present work is the characterisation and extraction of the volatile compounds present in pineapple and celery by-products and the subsequent evaluation of their antioxidant capacity. For this purpose, the analysis of the aromatic profile of selected by-products has been carried out using the headspace solid phase microextraction technique coupled to gas chromatography with mass spectrometry detector (HS-SPME-GC-MS). The optimisation of the HS-SPME phase was carried out using a Box-Behnken experimental design. The analysis of the total phenol content (TPC) has been carried out in addition to the analysis of the antioxidant capacity by means of different methodologies such as the antioxidant capacity to reduce ferric ion (FRAP), the method using 2,2'- azinobis (3-ethylbenzothiazoline-6-sulphonate) (ABTS) and the 2,2-diphenyl-1-picrylhydrazyl (DPPH) method. As a result, the studied by-products are of great interest for their contribution to the aroma of pineapple and celery and their antioxidant capacity. These characteristics allow a very wide range of applications where these by-products could be used, thus promoting the circular economy and reducing the amount of waste generated by the food industry.

Development of a Method for Measuring Chymotrypsin Inhibitor Activity in Soybeans and Other Legume Products

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Abstract:

Protease inhibitors of protein nature are ubiquitously distributed in the plant, animal, and microbial kingdoms. Inhibitors of pancreatic proteinases of higher animals, such as trypsin inhibitors and chymotrypsin inhibitors, are rich in seeds of legume crops (e.g., soybeans and pulses). Although protease inhibitors impair the nutritional quality of legume products, a few are found to be beneficial to humans and animals due to their therapeutic effect. Historically, trypsin inhibitor activity (TIA) in legume products has been of primary interest. However, as increasing volumes of plant proteins are being used for food or feed in recent years, there is a growing interest in monitoring chymotrypsin inhibitor activity (CTIA) in these products as well. Therefore, it is important to have a reliable method for accurately assaying CTIA. At the USDA, we developed an improved method for measuring TIA two years ago. It has recently been adopted by American Oil Chemists Society as an official method, Ba 12a-2020. This presentation reports our new effort in developing a CTIA assay method, using N-benzoyl-L-tyrosine p-nitroanilide as a substrate. Since the substrate is not water soluble, an organic solvent that is miscible with water must be used in the assay. After investigating the effects of organic solvents, the sequence of adding reagents and other factors, a new method for CTIA measurement was developed. It features an enzyme-last sequence, dimethylformamide as the organic solvent, and expression of results as chymotrypsin units inhibited per mg sample.

NMR Spectroscopy in Lipid Analysis

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Abstract:

NMR spectroscopy is a powerful tool that has been successfully used for the compositional analysis of complex mixtures, including foods and plants. Additionally, its coupling to chemometrics and machine learning approaches can be used for spectral pattern comparison and for the identification of biomarkers. Here, we focused on the analysis of oils, namely fish oil, coffee oil and avocado oil. We used certified fish oil standards and commercial samples to develop a 13C-detected NMR quantitative method for the analysis of EPA and DHA content in fish oil supplements. We also combined NMR and metabolomics for understanding the impact of roasting on the composition of the lipid fraction of coffee and for analyzing avocado oil and differentiate it from other edible oils including olive, canola, high-oleic (HO) safflower, HO sunflower and soybean oil.

Variation in the Essential Oil Composition of Turmeric Varieties Grown in North Alabama, USA

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Abstract:

Turmeric *(Curcuma longa L.),* a rhizomatous herb of tropical origin, is gaining importance as a medicinal herb in the USA. It is a popular spice extensively used in Asian cuisine and the traditional Indian medicine of Ayurveda. Curcuminoids are the main bioactive compounds in turmeric, but turmeric essential oils also have well-known health benefits. Turmeric is well adapted to warm, humid environments worldwide and is well suited for cultivation in the southern United States to meet the growing demand for locally sourced turmeric. In this study, the fresh mother (M) and lateral (L) rhizomes were hydrodistilled to obtain essential oils of the five varieties (CL3, CL5, CL9, CL10 & CL11) of C. longa cultivated in north Alabama, and the essential oils analyzed by gas chromatographic techniques. The oil color ranged from pale yellow to yellow, and the essential oil yields varied between 0.204% (CL10L) and 0.695% (CL9M). Varieties CL1, CL5, and CL9 gave better essential oil yields (0.443-0.659%) than CL3 or CL10 (< 0.3%). The major components in the essential oils were α-phellandrene (3.7-11.8%), 1,8-cineole (2.6-11.7%), α-zingiberene (0.8-12.5%), β-sesquiphellandrene (0.7-8.0%), ar-turmerone (6.8-32.5%), α-turmerone (13.6-31.5%), and β-turmerone (4.8-18.4%). Cluster analysis showed that varieties CL11, CL5, and CL9 were dominated by α-turmerone, ar-turmerone, and β-turmerone, and CL5 & CL10 had higher concentrations of α-zingiberene and β-phellandrene. The essential oil yields and chemical profiles of several of the varieties are comparable with those from tropical regions, suggesting that these should be considered for cultivation and commercialization in the southern United States.

Antioxidant Pectins and Fibers Rescued from Agro-Industrial Residues Useful for Food Preservation

Ana Maria Rojas

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Abstract:

Advanced valorization strategies involve the generation of multiple products by extraction of valuable components or chemicals. Agro-industrial by-products can be applied to the extraction of total fibers and pectins carrying co-

extracted antioxidants, useful for preservation of healthy processed foods. The polysaccharides (dietary fibers) from the cell-wall have functionalities of technological interest in food formulation. Alcohol or water insoluble total fiber fractions were separately obtained from discarded plums (peel and flesh) and cherries. As they carried extractable phenolics, proantocyanidins, tocopherols, and carotenoids, cherry fibers preserved milk from protein oxidation in a concentration-dependent manner (0-9% w/w), while plum fibers (2.5% w/w) preserved chicken patties from lipid oxidation (12-days-refrigerated storage. On the other hand, a pectin fraction (CP) was obtained from discarded carrots by treating the sugar-exhausted water-insoluble residue with a bacterial hemicellulase (citrate buffer, pH 5.2) after applying high-power ultrasound (20 kHz, 80% amplitude, 20 min net time; 12.27 W/cm2 Power intensity). CP contained 50% of uronic acids, which were 42% methyl-esterified and 14% acetylated (molar ratio). The mechanical spectrum of 2.0% w/v CP-aqueous solution with Ca2+ (30 mg/100g uronic acids) revealed a true gel with G' = 400 Pa. The significant contents of carotenoids and –tocopherol gave orange-color and antioxidant capacity to CP when evaluated on a 20:80 w/w chia-oil/water emulsion (45 d storage, 25°C), and on a cashew vegan cheese (60 d storage, 7°C) covered by a 100%-CP edible film, which was water-resistant probably due to the lipophilic antioxidants.

Typicality of French Ossau-Iraty Cheeses by Direct Injection Mass Spectrometry

Marine Reyrolle

The University of Pau and the Adour Region, France

Abstract:

Volatile organic compounds (VOC) emitted by food products are decisive for the perception of their aroma and taste. The analysis of these gaseous matrices is traditionally done by detection and quantification of few dozens of characteristic markers. Emerging direct injection mass spectrometry (DIMS) technologies, such as PTR-MS or SIFT-MS, offer rapid analysis of complex gas matrices based on a soft ionization of volatile compounds without previous separation. The increase of selectivity offers by the use of several precursor ions coupled with untargeted analysis increases the potential power of these instruments. However, the analysis of complex gaseous matrix by DIMS results on the one hand in a large number of ion conflicts, making the quantification of markers very difficult, and on the other hand a large volume of data for every sample. A solution based on the shift toward the omics domains of these analyses, where the number of variables is much higher than the number of samples, requires the use of adapted extraction and statistical analysis tools. In this work, we used SIFT-MS to determine the volatile fingerprints of Ossau-Iraty PDO sheep milk cheeses and applied mixOmics statistical methods for results exploitation. This methodology allowed to illustrate the typicality brought by each producer, the reproducibility of the manufacturing processes and the impact of the animals' diet on the final product.

Triple Detector for Characterization of Antioxidants in Olea europaea

Yubin Ding

Free University of Bolzano, Italy

Abstract:

The official herb *Olea europaea* was widely applied in food and pharmaceutical industries due to the high antioxidant capacity. However, their antioxidant compound profile was remaining unknown. This work demonstrates the use of the coulometric array detector (CoulArray) coupled to liquid chromatography, diode array detector (DAD) and mass spectrometry (MS) for screening of antioxidants in Olea europaea. The CoulArray detector can assess the potential of molecules to oxidize and determine their electrochemical behaviour based on multiple channels poised at different potentials. In this research, the Coularray was applied to select the main antioxidant compounds from Olea europaea with charge transfer ability higher than 5 μC. Meanwhile, the DAD was applied to first screening all the bioactive compounds from the extracts and the MS was used to identify all the selected compounds. From the result, the Oleuropein was determined as the bioactive compound with the highest antioxidant capacity, followed by hydroxytyrosol. The transferred charge accumulated from the multichannel was used to quantify the main antioxidant compounds with the application of the Faraday's law. The oleuropein and hydroxytyrosol content was

determined at 7.36 and 3.44 mg per gram of dried herb, respectively. A hydrodynamic voltammogram, which shows the electrochemical behaviour of Olea europaea was draw and compared with other officinal herbs and antioxidant standards to further analyze the antioxidant activity of Olea europaea. In conclusion, the applied triple detector system presented a swift way for analysis of antioxidant compounds in Olea europaea and can be further applied to different natural herbs.

Session II – Food Microbiology, Safety and Preservation

Active or Passive Chemical Approaches for Control of Food Spoilage- and Crop Disease- Fungi

Simon Avery

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Abstract:

Fungal spoilage organisms and crop pathogens contribute significantly to annual food losses globally. Approaches for control of these organisms traditionally rely on the use of chemical actives, e.g., fungicides, preservatives. There is tightening legislation and consumer concern over the use of such agents and fungal resistance to common fungicides is growing. Consequently, alternative strategies are highly sought. Among such possibilities are combinations of agents that act synergistically. Although involving more than one chemical, synergies can reduce total chemicals usage. They may also help target different subpopulations in heterogeneous cell/spore populations, which can otherwise enable harmful fungi to persist after treatment with a single agent. Passive, physical measures could offer an important, actives-free option for fungal control. Recent work has revealed polymer materials that passively resist attachment and colonization by fungi. This is important because such attachment of fungi to surfaces is a key first step that precedes many of the problems that they cause. The presentation discusses selected approaches in the context of current challenges for fungal control.

Reaction between Amino Acids and Polyphenols with Reactive Aldehydes in Foods and Their Safety Concerns

Jie Zheng

Jinan University, China

Abstract:

Acrolein, 5-hydroxymethylfurfural, and di-carbonyl compounds, such as methylglyoxal, glyoxal and 3-deoxyglucosone, are harmful substances generally produced during thermal processing of foods. They exhibit substantial deleterious effects on human beings by reacting with proteins and DNA or the generation of other toxins in vivo and in food. Amino acids and polyphenols ubiquitously exist in foods, and are intensively used to control the levels of these toxins in foods. The mechanism involves the generation of aroma compounds (between di-carbonyl compounds and amino acids), as well as the formation of various adducts via Michael addition or the Maillard reaction between amino acids or polyphenols and the aldehydes. Consequently, the blank knowledge on the absorption, metabolism and toxicology of the neo-formed adducts catches our specific concerns and interest on their impact on the in vivo and food safety. In recent years, we demonstrated that different adducts formed between various amino acids and polyphenols with aldehydes displayed different toxicity in cellular and animal models, some of which might result in higher toxicity than their aldehyde precursor. The findings indicated that the safety consequence of toxic aldehydes after scavenged by amino acids and polyphenols needs to be concerned and investigated in-depth.

Rapid Authentication of Meat Components Based on the Molecular Amplification Integrated Protocols

Wei Chen

Hefei University of Technology, China

Abstract:

Adulterations of meat have many serious effects to the commercial products and also many potential threatens to the human wellness. Traditional methods including the spectral protocols and immune protocols cannot realize the rapid and on-site detections. Taking nucleic acid as the target analytes can effectively resolve the mentioned drawbacks of traditional methods. In this presentation, we summarized our recent research about the rapid and accurate authentications of meat adulterations by molecular amplification-based protocols. Meanwhile, both common amplification strategies and isothermal amplification strategies were adopted and integrated with other easy-operational or portable devices with low-cost. The functional primer design, fluorescence polarization, and lateral flow strip methods have been well integrated with various molecular amplification strategies. Finally, the constructed molecular amplification based have been well applied in the simulated and commercial meat products. All constructed methods can also be applied in other filed including microorganism or clinical detections.

Formation of the Adducts Formed Between Acrylamide and Amino Acid in Foods

Caihuan Huang

Jinan University, China

Abstract:

Acrylamide is a food contaminant abundantly occurring in some processed foods, which contains reactive α, β-unsaturated carbonyl group. The previous studies mainly focused on the formation and toxicity of acrylamide, while its fate in foods remains uninvestigated. Our previous research found that acrylamide easily formed adducts with amino acids, which underestimates the real exposure of acrylamide in foods and arose possible food safety problems. In this research, the formation of such adducts between acrylamide and three common amino acid, including lysing, glycine and cystine in food, has been investigated thoroughly to reveal mechanisms of acrylamide-amino acid formation, and their corresponding contribution to the elimination of acrylamide in processed foods. The adducts was purified with column chromatography and HPLC, and their structures were elucidated by one- and two-dimensional NMR spectroscopy, MS data analysis. Moreover, cell line Caco-2 was used to analyse the absorption properties in cell line Caco-2. The research is of critical importance to elucidate the elimination mechanism of acrylamide by amino acids in processed foods. The results of current project will provide a new insight into the research of food hazardous materials in thermally processed foods.

Application of High-Resolution Mass Spectrometry for the Evaluation of Migrating Chemicals Coming from Plastic Food Packaging Materials

Maria Jose Gomez Ramos

University of Almeria, Spain

Abstract:

EU legislation requires that chemicals migrating from food packaging into food do not endanger human health. A proper safety assessment must go further than simply testing for known ingredients used to make the packaging materials. The identification of all potential migrants, including non-intentionally added substances (NIAS), is

required to assess the safety of these materials. However, the identification of unknown migrants from food contact materials (FCMs) is an issue for scientists. Since neither spectral databases nor analytical standards are available for most of the NIAS. This work shows the high potential of non-targeted approaches using high-resolution mass spectrometry (HRMS) in combination with software tools for data acquisition and data treatment for the identification of unexpected migrants in food simulants and food from plastic packaging materials.

Rapid Control of Undeclared Sources of Meat in Foods: Recombinase Polymerase Amplification with Test Strip Detection to Identify Presence of Chicken and Pig Meat

Anatoly V. Zherdev

Research Centre of Biotechnology of the Russian Academy of Sciences, Russia

Abstract:

Verifications the authenticity of meat products is relevant due to the growth of their counterfeiting. Rapid technique for identification of undeclared pork and chicken components in meat products has been developed for this purpose. The technique includes 3 min of DNA crude extraction, 20 min of recombinase polymerase amplification (RPA) at 39°C, and 10 min of lateral flow assay (LFA) detection. Cytochrome B gene is used for chicken and pig identification. The selected primers provide specific RPA without DNA-nuclease and additional oligonucleotide probe. In result, RPA-LFA based on designed fluorescein- and biotin-labeled primers detect up to 0.2 pg total DNA per µL which provides identification up to 0.001% w/w of target meat component in composite product. The technique was successfully applied to processed meat products and to meat after heating. The obtained results were in accordance with real-time PCR. The developed analysis is specific and allows detecting pork and chicken impurities with high accuracy. The proposed rapid full-cycle technique can be adopted for authentication of other meat products. *The study was financially supported by the Russian Science Foundation (Grant 19-16-00108).

Effect of *Porophyllum linaria* Essential Oil with Antifungal Activity on Flour and Baked Product Quality

Zaida N. Juárez

Popular Autonomous University of the State of Puebla, Mexico

Abstract:

Wheat is one of the most consumed cereal in the world and, during storage, is attacked by various pests, among these the most worrisome is that of carcinogenic toxin producing fungi, as they can seriously affect human health. To combat pests, often synthetic pesticides are used which by their persistence, may lead to find them even in processed foods, affecting human and animal health, as well as the environment. Essential oils extracted from plants are an alternative to the use of synthetic pesticides because they have showed activities against bacteria, fungi, and viruses. In this work, we reported the antifungal activity of the essential oil extracted from Porophyllum linaria, endemic species from México, against 11 fungal strains isolated from stored wheat. Also, we supplemented wheat grains with the same essential oil and prepared bakery dough to assess potential changes in its physical properties, using the flour obtained from these essential oiltreated wheat grains. Besides, macrophages (THP-1) and Artemia spp. models were used to evaluate theirtoxicity; while the inflammatory response was assessed by measuring the secretion of cytokines IL-6 and TNF-α, using macrophages. Results showed potent antifungal action on 3 of the 11 strains of fungi, exhibit moderate to null toxicities and no inflammatory response was detected; also it did not significantly alter the physical properties of either flour, bakery dough or cookies, suggesting that the presence of oils in the grains are safe to use.

Challenges to Using Recycled Post-Consumer Polyolefins as Food Contact Materials (FCMs)

Greg Curtzwiler

Iowa State University, United States

Abstract:

Use of post-consumer polyolefin is increasing due to the pledges of multiple organizations to use higher concentrations of recycled materials in packaging. However, direct food contact applications are challenging with various worldwide regulations for direct food contact safety. Requirements are often determined by the condition of use (microwave, cold storage) and food type (fatty, aqueous, dry). This presentation will discuss techniques and methods to quantify and assess the safety of recycled materials. A review of different diffusion models used to study contaminant migration from packaging to food contact articles and the role of different contaminants during polymer processing will also be discussed. This review will provide the necessary background to assess potential problems from the presence of harmful compounds affecting human health, degradation of material properties, and environmental impact.

Combinatorial Peptides Extract from Probiotics Reduce the Deterioration of Ready-To-Eat Mango Wedges

Gabriela N. Tenea

Technical University of the North, Ecuador

Abstract:

Ready-to-eat mangos are commonly sold as wedges in plastic cups at ambient temperature by mobile vendors in Ecuador, thus they are prone to contamination by bacteria, which poses a safety issue of concern. This work aimed to evaluate the effect of several antimicrobial cocktails consisting of previously designed specific peptide extracts from two probiotic bacteria Lactobacillus plantarum UTNCys5-4 and Lactococcus lactis subsp. lactis UTNGt28, along with nisin, a commercial food additive, on mango wedges artificially inoculated with a logarithmic phase culture of a five-strain bacterial mixture. Preliminary bacteriological analysis of mango wedges purchased from mobile vendors showed the presence of multiple antibiotic-resistant bacteria indicating non-compliance with the food safety standards. The results revealed that two antimicrobial cocktails, containing cell-free supernatant based (CFS) and precipitated peptides (PP)-based cocktails applied at dose 1:3 (v/v), inhibited the colonization of total bacterial counts with 56.03% and 55.61% in mango wedges. The reduction of total E. coli counts was 64.93%, while Salmonella and Shigella counts were reduced by 98.09% and 97.93%, respectively, when mango wedges were treated with CFS antimicrobial-cocktail. The commercial nisin inhibited total Salmonella spp. counts by 40.13%, while E. coli spp. and Shigella spp. diminished by 28.20% and 37.22%, respectively. Moreover, we showed that PP formulation but not nisin damaged the target cell integrity, thereby eventually inhibiting their growth and reproduction. The selected antimicrobial cocktails exerted a bacteriolytic effect in mango wedges. Thus, using peptide combinatorial treatments to combat drug-resistant bacteria in ready-to-eat fruits might be a solution to be further considered.

From Starter-Assisted to Fermentome-Driven: A Paradigm Shift in Sourdough Fermentation

Hana Ameur

Free University of Bolzano, Italy

Abstract:

The application of omics techniques helps to further unravel sourdough fermentation potential. Meta-genomic, culturomic, metabolomics and meta-transcriptomics analyses of eight sourdoughs representative for different countries in the world were performed. Cultivable bacteria and yeast species identified by the culture dependent methods were also identified by meta-genomic approach. Metagenomics analysis described the sourdough metagenome, including dominant bacterial and fungi strains and subdominant population. The metabolic functions identified by KEGG strongly support the evidence of sourdough fermentation. Multi-copies genes encoding for enzymes involved in key sourdough metabolisms were identified in sourdoughs. Meta-transcriptomic profiles of the different sourdoughs confirmed the expression of core genes encoding for the biosynthesis or catabolism of amino acids by sourdough lactic acid bacteria. From the comparison of all omics data, emerged a clear picture of the potential metabolic background vs. metabolisms expressed under sourdough conditions. The ecological fundaments retrieved will ensure the resilience sourdough-fermented doughs to various causes of disturbance. The results of this study will allow the industrial development of the most stable and performing mixture of microbes to drive the sourdough fermentation.

From *Cynara cardunculus* Biomass to Active Protein-Based Films

Seyedeh Fatemeh Mirpoor

University of Naples, Italy

Abstract:

Cardoon (*Cynara cardunculus*) is a plant that can grow in hot and dry region, as well as in abortive soil with a high productivity. Therefore, bioactive compounds and proteins were extracted from cardoon leaves and seeds. Naviglio® technology was used to extract from leaves bioactive compounds with high phenol content and oxygen scavenging activity. Moreover, cardoon proteins (CPs) revealed the ability to give rise by casting to greenish films, in the presence of glycerol (Gly) used as plasticizer, possessing promising mechanical and barrier properties. Accordingly, to develop a bioactive film, the cardoon leaf extract (CLE) was added to the obtained CP- based films and further characterized. Microstructure of the produced films, studied by scanning electron microscopy, showed an uniform distribution of CLE among the film network. Moreover, the CP-based films developed in the presence of CLE exhibited an improvement in the mechanical and barrier properties, higher hydrophobicity and a marked antioxidant activity in comparison with the film obtained in the absence of CLE. The obtained results revealed the potential of Cynara cardunculus to be used as a biorefinery where different low-value renewable biomass materials are turned in several higher value bio-based products.

Session III – Symposium on Food Hydrocolloids

Post Consumption Hydrocolloid Interactions Affecting Digestion Kinetics

Alan Mackie

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Abstract:

Glycemic index is a good example of a parameter that highlights why digestion kinetics can be important for health. Soluble dietary fibre is a hydrocolloid that can have a profound impact on digestion other than as a substrate for microbial fermentation. In the upper GI tract, the ability of hydrocolloids to increase viscosity can decrease bioactive absorption kinetics through a range of effects. Firstly, gastric emptying can be slowed, either by increasing the viscosity of gastric chime or by preventing the phase separation of lipids. Secondly, increasing the viscosity of chyme in the small intestine can decrease mixing and thus slow transport of digestion products to the sight of absorption. Finally, hydrocolloid interactions with intestinal mucus can decrease its permeability. To what extent do these different mechanisms play a role in glycemic response and the kinetics of digestion of other nutrients? In

addition to the passive effects on mixing and transport of digestion products, can binding of bioactives to dietary fibre also alter their bioavailability? Certainly, the interactions between endogenous bile acids and dietary fibres such as beta glucan is thought to be at the heart of the ability of such high molecular weight polysaccharides to lower cholesterol. How can we make the most of our understanding of all these affects to benefit human health?

Study on Gelation Mechanisms and Network Structures in Carrageenan Gels from Macro and Microscopic Viewpoints

Shingo Matsukawa

Tokyo University of Marine Science and Technology, Japan

Abstract:

Rheological measurements on carrageenan gels provide information about gelation mechanism and network structure from macroscopic viewpoints. On the other hand, measurements of microscopic physicochemical properties are instructive to give mobility and structures in nanometer and molecular level. The gelation of KC and IC solutions is considered to be induced by the formation of double helices and their aggregation which generate an exothermic peak in micro-DSC, where the peak temperature is mostly identical with the gelation temperature and the peak area is corresponding to the enthalpy for the formation and aggregation of helices. The molecular mobility of carrageenan chains are strongly decreased by formation and aggregation of helices. NMR relaxation times reflect flexibility of the chains. The diffusion coefficients give the information about the mobility of molecules and the structure of the hydrocolloids. Nano-particle tracking is a noninvasive technique performed by monitoring the Brownian motion of the probe particle which provides information on the local viscoelasticity in carrageenan gels and spatial differences in the local physical properties during the gelation of the media.

Innovative Food Ingredients Based on the Chitosan-Milk Protein Complex Particles for the Fortification of Food with Essential Lipids

Maria Semenova

N. M. Emanuel Institute of Biochemical Physics of Russian Academy of Sciences, Russian Federation

Abstract:

Within recent years there has been a growing research interest in the potentialities of using of the associative interactions between food proteins and polysaccharide from natural sources in designing of tailor-made micro- and nano- colloidal particles. These particles could be used as delivery systems for the essential biologically active substances and could be involved as "the physiologically-functional ingredients" in the manufacture of food stuff with enhanced nutritional quality and health benefits. This research demonstrates the structure-functions relationships revealed for the ternary complex particles formed by chitosan (CHI: Sigma, Mw = 50-190 kDa, deacetylation > 75%) with milk proteins (sodium caseinate (SC: Sigma, New Zealand) or whey protein isolate (WPI: Unflavored BiPro, Davisco Food International, USA) and natural essential lipids. These lipids contained the equimass amount of the essential omega-3 and omega-6 polyunsaturated fatty acids from soy phosphatidylcholine (PC: Lipoid S-100, Germany) liposomes loaded with triglycerides of fish oil (the sum of omega-3 eicosapentaenoic and docosahexaenoic fatty acids > 50%). These ternary complex particles were water-soluble and nanoscale. The main relationships were elucidated in the following series: the character (nature and strength) of the associative interactions between chitosan and milk proteins - the structure of the ternary (chitosanmilk proteins-lipids) complex particles - the ability of these complex particles to perform functions of the innovative ingredients like the protective delivery systems for the essential lipids. This work was financially supported by the Russian Science Foundation (Grant 21-16-00085).

Application of Interfacial Covalent Interaction in the Formation of Emulsions

Yan Li

Huazhong Agricultural University, China

Abstract:

Food, as a complex system, contains multiple components (such as water, protein, lipids, carbohydrate, minerals, nutrients, pigment and flavor) and phases (such as gas, liquid, solid, liquid crystal). Many interactions naturally occur among those components in this complex system. Flavor compounds are one of the most common food additives in food processing to enhance the acceptability of food to consumers. They can also interact with the food components, like lipids, carbohydrates and proteins by various interaction forces. Most of flavor compounds are hydrophobic and have some reactive groups in the chemical structure. They can bind with other components by irreversible covalent linkages. Hence, we created an interfacial reaction in the emulsion system based on the interaction of hydrophobic aldehyde and hydrophilic proteins or chitosan. The interfacial reaction occurred during homogenization without any extra input. Our results demonstrated that the presence of interfacial reaction could greatly improve the stability of emulsions and provide more functional performances for emulsions. We think that it would be a promising way to modulate the properties of emulsions.

Effect of pH on the Mechanical, Interfacial, and Emulsification Properties of Chitosan Microgels

Nan Yang

Hubei University of Technology, China

Abstract:

Food microgels have attracted much attention recently especially in the use of emulsion stabilization due to their colloidal nature, such as nano- to micro- size, large amount of dangling chains and deformability. However, the stabilization mechanism for pH-sensitive microgels is still not well understood. In this paper, the polysaccharide chitosan (CS) was used to prepare pH-responsive chitosan microgels (CSMs) by physically cross-linking with sodium tripolyphosphate (TPP) and the subsequent ultrasound treatment. The results showed that the size of the CSM particles strongly depended on pH with larger size under weak acid conditions and smaller size under neutral condition. CSMs obviously have better interfacial activity than pure CS polymers under the same conditions, and their interfacial properties strongly depended on pH and concentration. It was found that although the swollen CSM particles diffuse more slowly than the smaller ones, they formed interface with stronger viscoelasticity, and displayed strain hardening during extension process in the dilatational measurement under relatively large amplitude. Combined with the mechanical strength results, these may be due to the greater deformability of the swollen CSMs at weak acid condition. However, over swelling may not facilitate the decrease of surface tension due to the steric and electrostatic repulsion of the dangling chains. The interfacial behaviors of the CSMs were successfully linked to their emulsification ability and confirmed by the emulsion structure and stability tests. It was found that the interfacial viscoelasticity play a vital role in the emulsification ability of the CS microgels.

Realistic Computer Simulation for Analyzing Food Flow during Swallowing

Yukihiro Michiwaki

Japanese Red Cross Musashino Hospital, Japan

Abstract:

Swallowing is an intrinsic motion to transfer food from the mouth to the esophagus through the pharynx; however, food occasionally fails to flow in the intrinsic way but enters the lung through the larynx and trachea.

This is called aspiration. Clinical knowledge indicates that appropriate food choice can reduce the aspiration risk even in dysphagia patients susceptible to pneumonia. For example, hydrocolloids like xanthan have been extensively added to make thin liquids including water more viscous for preventing aspiration for frail people with swallowing difficulty. However, nobody knows how the hydrocolloids change the food flow, because direct vision of the food flow and digestive tract deformation is impossible. To analyze the food flow, we have developed a realistic computer simulation created based on medical images. The subjects were a healthy young person and an elderly patient with aspiration. The test food was a Newtonian fluid (viscosity 2.5 mPa · s) and a non-Newtonian fluid (viscosity 300 mPa · s at a shear rate of 50 [1/s]) including viscous agent like xanthan. The results indicated that the median shear rate ranged from 75 to 200 [1/s], and there were three peaks. In the swallowing of the non-Newtonian fluid, the flow velocity smoothly changed between 0.1 and 0.5 m/s, the shear rate varied between 50 and 100 [1/s], and the average of the median values during the entire swallowing process was 78 [1/s]. These results indicate that the numerical simulation based on medical images can analyze the food flow during swallowing.

Active Edible Coatings to Enhance Quality and Storability of Fresh Food Products

Elena Poverenov

Agriculture Research Organization, The Volcani Center, Israel

Abstract:

Nature-sourced edible active materials can enhance quality and storability of food products and protect them from microbial, environmental and mechanical damages. The active biodegradable and biocompatible coatings based on such materials also respond to customer demands for safe and healthy approaches for food quality management and satisfy ecologic concerns. Our active coatings may combine biodegradable biopolymers and nature-sourced bioactive materials. We are utilizing advanced material science and nanotechnology approaches to develop advanced safe and effective coating for enhancing quality and storability of fresh food products. Layer-by-Layer (LbL) approach, emulsification, molecular encapsulation and self-assembly are utilized to control properties and functionality of the developed coatings. Our active coating and films based on edible nature-sourced biopolymers were successfully implemented to improve microbial safety, physiological and nutritional quality of various fruits and vegetables. Edible coatings were also found to be outstandingly effective for enhancement of quality and storability of ready to eat fresh-cut produce.

Viscoelastic Properties of Durum Wheat Doughs Enriched with Soluble Dietary Fibres in Relation to Pasta-Making Performance and Glycaemic Response of Pasta

Donatella Peressini

University of Udine, Italy

Abstract:

The aim of this work was to evaluate the effects of soluble DFs on viscoelastic properties of durum wheat dough, pasta-making performance and glycaemic response of dry pasta. Psyllium, Barley Balance, long- and short-chain inulins were added individually and in combination to obtain DF-enriched doughs with large differences in rheological properties to understand their role in the manipulation of predicted glycaemic response. Dough rheological properties were investigated using frequency and temperature sweep tests in the linear viscoelastic range. DF-enriched doughs showed large differences in elastic properties between 25 and 95 °C due to differences in the number of interactions between components and the swelling of gelatinized starch granules. A correlation between in vitro glycaemic response of pasta and a swelling index obtained from rheological tests was observed. Swelling of starch granules decreased with the increase in elasticity and water absorption of fibre-enriched doughs up to a critical value. Pasta containing fibres was stickier and gave higher cooking loss. Changes in firmness was dependent on dough viscoelasticity. Proper blend of fibres appeared to solve some issues limiting the use in the product.

Viscoelastic properties of DF-enriched doughs are determinant for nutritional and technological performances and their knowledge provides useful information for the development of functional products. Both sensory quality and health evidence require a certain dough elasticity, which is the result of interactions at molecular scale. It is important to pay attention to the incorporation of DF blend in pasta since antagonist or synergic effects may occur and influence their functionality.

Modulating the Adsorbance of Particles at the Interface of Water in Water Emulsions

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Abstract:

Water-in-water (W/W) emulsions are formed by mixing aqueous solutions of incompatible macromolecules. W/W emulsions cannot be stabilized by molecular surfactants, but they can be stabilized by larger particles in the same manner as was long since known for oil-water emulsions. For the particles to adsorb at the W/W interface the difference between the interfacial tensions of the particle with phase A and B needs to be smaller than the interfacial tension between the phases ($|\gamma_{PA} - \gamma_{PB}| < \gamma_{AB}$. Optimal adsorption is achieved when $\gamma_{PA} - \gamma_{PB} = 0$. In that case excess particles partition equally between the two phases. We studied a W/W emulsion formed by mixing pullulan and amylopectin in the presence of whey protein microgels. We showed that ($\gamma_{PA} - \gamma_{PB}$) can be modulated by adding small amounts of a third polysaccharide that mixes with both phases and does not interact specifically with the microgels. In the absence of the third polysaccharide the microgels partitioned to the pullulan phase and did not adsorb at the interface. After adding 0.1 wt% pectin, alginate or carrageenan, the microgels partitioned to the amylopectin phase and did still did not adsorb at the interface. However, by fine tuning the amount of added polysaccharide, equal partitioning could be achieved, in which case the microgels adsorbed even if the emulsion was diluted to very close to the binodal. This phenomenon was also observed using cellulose nanocrystals instead of protein microgels.

Seed Coat Mucilages: Structural, Functional/Bioactive Properties and Genetic Information

Qingbin Guo

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Abstract:

Seed coat mucilages are mainly polysaccharides covering the outer layer of the seeds to facilitate seed hydration and germination thereby improving seedling emergence and reducing seedling mortality, especially in arid and sandy environments. Four types of polysaccharides are found in mucilages including xylan, pectin, glucomannan and cellulose. Recently, mucilages from flaxseed, yellow mustard seed, chia seed, etc., have been used extensively in the areas of food, pharmaceutical, and cosmetics contributing to stability, texture and appearance. This review for the first time addresses the similarities and differences in physicochemical properties, molecular structure, and functional/bioactive properties of mucilages among different sources, highlights their structure & function relationships, systematically summarises the related genetic information, aiming to explore the potential functions thereby extending their future industrial applications.

Alginate Fluid Gels for the Encapsulation and Release of Small Molecular Weight Model Actives

Fotis Spyropoulos

University of Birmingham, United Kingdom

Abstract:

The inclusion of actives within biopolymer-based gelled microparticles has generated substantial interest, but such systems still face challenges for scalable production. Fluid gels are a class of soft-solid particles produced via high-shear approaches that are suitable for industrial manufacture. However, work on fluid gels has been focusing on their uses as rheology modifiers and their utilisation for the entrapment of species of therapeutic/nutritional activity has been scarcely investigated. The present work studies the encapsulation/retention of different small molecular weight actives of varied hydrophilicity/hydrophobicity within alginate fluid gels (AFG). The presence of an active during AFG formation did not interfere with gel particle dimensions nor bulk rheological behaviour. Immediately following production, encapsulation of all actives within the FG particles was very low, but significantly increased for the hydrophobic ones over storage. The rate and extent of hydrophobic active loading in the AFG particles were governed by the concentration of the former and FG particle size. Release studies revealed that hydrophobic active content enclosed within the AFG particles is not expelled and remains fully entrapped regardless of FG particle size and storage period. A hypothesis suggesting that the loading of hydrophobic actives within the AFG particles is due to changes to the solvent quality of water, will be presented. Overall, the current study offers insight into the use of AFG as encapsulation media and presents original findings that can greatly support future efforts to expand the applicability of these industrially-relevant colloidal systems.

Rheological Assessment of the Effect of Additives on the Stability of Chia *(Salviahispanica L.)* Mucilage Suspensions

Francesca Cuomo

University of Molise, Italy

Abstract:

Due to the benefits deriving from its composition, chia seed mucilage is an emerging resource in food industry applications. In food processing, the combination of different physical-chemical parameters is encountered; therefore, a thorough knowledge of the effect of these parameters on the raw material is required. In this contribution, starting from the effect of temperature and pH on the rheological properties of chia mucilage suspensions, the influence of ionic strength and time were considered together with the addition of stabilizing molecules. The rheological analysis performed on mucilage suspensions showed a plastic behavior of the fluid. Among the parameters considered, the increase of temperature and ionic strength cause a decrease in the apparent viscosity of mucilage suspensions. Apparent viscosity is also strongly influenced by the time and ionic strength. In the presence or in the absence of salts, indeed, a decrease in the consistency index is observed during suspensions storage. This evidence indicates that the suspensions are not stable. To improve the stability of the suspensions glycerol, a plasticizing compound, was used. The addition of glycerol only partially attenuates the instability of the suspensions. Moreover, considering that auto-oxidative phenomena can affect chia mucilage, hydrophilic and hydrophobic antioxidants were added to the suspensions. The hydrophilic antioxidant had positive effects at low concentration while hydrophobic antioxidant was more effective for stabilizing mucilage.

Bioactive Hydrocolloids: Structures, Bioactivities and Applications

Steve W. Cui

Guelph Research and Development Centre, Canada

Abstract:

Hydrocolloids include proteins and polysaccharides with functional properties, such as exerting viscosity, ability to form gel, stabilize emulsions and as encapsulation wall materials. Bioactive hydrocolloids are mostly plant/fungi based polysaccharides with special structure features which has been demonstrated a varieties of bioactivities, including but not limited to, immune moderating, anti-cancer, anti-oxidant activities. This presentation will

review the most recent research developments in structural elucidations using 2D NMR Spectroscopies, MALDI-TOF Mass Spectroscopy and classical methylation analysis methodologies. Bioactivity assessment and structure-bioactivity relationships of three groups of polysaccharides will be discussed: plant based, fungi based and animal based polysaccharides: their structure characteristics and associated bioactivities. Some bioactivities of commercial available hydrocolloids will be also discussed and their applications in pharmaceutical and healthy food applications will be explored.

Extraction of Viral Coefficients from Phase Diagrams

Arjen Bot

Unilever Foods Innovation Centre, Netherlands

Abstract:

Phase separation of biopolymers is a ubiquitous phenomenon in food products. Surprisingly little effort has been put in integrating the wealth of experimental data on phase separation available in literature to make practical predictions for phase separation. Practical predictions here refer to forecasts that may not achieve the highest level of accuracy, but are sufficiently precise to guide a researcher or a product developer. Here we present a method to achieve this that is based on the Edmond-Ogston model, where an exact expression for the critical point in terms of the viral coefficients can be derived (ACS Omega 6, 7862-7878, 2021). Simultaneous analysis of the critical points of multiple mixtures with common biopolymers allows for extraction of the virial coefficients, that are necessary to describe the complete phase behavior. The method is illustrated for PEO-dextran mixtures, which were chosen because these mixtures are well-studied in a large number of independent publications. This approach opens the opportunity to create a database of second virial coefficients that allows for semi-quantitatively predictions of phase diagrams by using data readily available from literature.

Alginates and Obesity

Matthew Wilcox

Newcastle University, United Kingdom

Abstract:

Alginates are a dietary fibre extract from brown seaweed and can also be harvested from certain bacteria. Alginates have been used in the food industry for many years as a thickener, stabilizer and emulsifier but their bioactive properties are underutilized. We have demonstrated that certain alginates can reduce the activity of digestive enzymes, particularly pancreatic lipase. If the action of pancreatic lipase can be modulated then the amount of dietary lipid absorbed by the body can be reduced, potentially cutting out a significant amount of calories per day from the food that is consumed. The reduction in lipase activity has been demonstrated in simple in vitro assays using both synthetic and natural substrates, achieving greater than 70% inhibition with certain alginates. The same alginates have been tested in a physiologically relevant model of human digestive tract, in various formats including free powder, capsules and foods such as bread. The alginate bread has been included in several human trials, initially looking at acceptability and gastrointestinal wellbeing over a sustained period of consumption, and in a pilot proof of concept, fat digestion study in ileostomy patients. These two human trials demonstrated that alginate bread did not have any negative gastrointestinal side effects, and did reduce circulating triacylglycerol levels in the blood and increased the amount of lipid leaving the small intestine compared to a standard white bread. Currently a 12-week randomized controlled weight management trial is being conducted in healthy volunteers.

Emulsion Stabilising Properties of Maillard Conjugates Formed by Fragmented Vegetable Proteins and Polysaccharides

Rammile Ettelaie

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Abstract:

Recent trends concerning green issues and sustainability, as well as a significant increase in the number of vegan consumers, has focused the attention of many food scientist on the challenges of using plant proteins as possible substitutes for animal proteins in everyday common food products. In food colloid formulations, one of the most critical functional ingredients, namely food emulsifier/emulsion stabilisers, frequently tend to be animal-based proteins and in particular milk proteins (casein, WPI, etc). However, the use of vegetable proteins as suitable replacements is not helped by their rather poor solubility, globular nature and their slow unfolding and adsorption kinetics. Various techniques for improving the emulsifying performance of vegetable proteins have been suggested, including the possibility of forming protein + polysaccharide Maillard conjugates. Yet, the difficulties in dissolving and obtaining an intimate dry mix of protein and polysaccharide, essential for efficient production of such conjugates, significantly hinders the use of this approach. In the present work, we examine the possibility of forming conjugates between fragments of protein and polysaccharides as means of overcoming these limitations. We show that when soybean protein hydrolysis is achieved by more specific enzymes (e.g., trypsin), and is followed by selection of more water-soluble portion of the resulting fragments, conjugates with reasonable emulsifying properties can be produced. Emulsion droplets of sub-micron size were successfully fabricated and remained stable for more than 2 weeks, under neural pH conditions. Nonetheless, at lower pH or for high salt concentrations the droplets do become unstable, suggesting that electrostatics still plays a significant role in stabilising these droplets. The crucial role of the degree of hydrolysis in determining the emulsifying properties of such conjugates is highlighted, both through experimental results and SCF calculations for the same systems, with optimum DH found to be around 8% for SPI hydrolysed with trypsin. It is shown that at lower level of hydrolysis, the fragments are not soluble enough, and yet at higher DH they are too small to provide sufficient amphiphilic properties for good adsorption of conjugates to the surface.

Water-in-Water (W/W) Emulsions Obtained by Condensation Methods

Jordi Esquena

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Abstract:

Water-in-water (W/W) emulsions are liquid/liquid biphasic systems that consist of droplets of one aqueous solution, dispersed into another aqueous solution. Both solutions contain water as the common solvent, and are in thermodynamic equilibrium because of the incompatibility between two hydrophilic solutes. W/W emulsions can be prepared in mixtures of proteins and polysaccharides, without oil and without surfactant, and thus, they constitute biocompatible carriers for delivery of active components. These emulsions can be properly stabilized by the adsorption of particles on the interface, and many examples of Pickering W/W emulsions have already been reported. In the present work, we have studied new simple and scalable emulsification methods for the preparation of W/W emulsions, based on oversaturation and condensation of droplets. The phase behavior of aqueous mixtures of hydrophilic polymers is highly dependent on pH, salinity, temperature and composition. Variations in phase behavior can be applied to "spontaneously" form water-in-water emulsions, by selecting the optimal compositions and inducing phase transitions. Various aqueous systems composed of a protein and a polysaccharide have been studied. The formation of W/W emulsions has been induced by various methods that include: (a) changing temperature, (b) varying pH, and (c) addition of a third polymer. Several examples will be shown, which demonstrate that phase transition methods allow to obtain W/W emulsions with smaller droplet size and longer stability, in comparison to the conventional methods based on applying agitation.

Encapsulation of Curcumin in Liquid Lipid Nanocapsules

Julia Maldonado-Valderrama

University of Granada, Spain

Abstract:

Liquid Liquid nanocapsules (LNCs) can be incorporated into food to deliver low soluble nutrients or bioactive compounds such as curcumin. These are solublised in oily cores and shelled by different interfacial materials. Nanotechnology and interfacial design offer the possibility to tailor the size, shape and protective layers of nanocapsules providing protection and controlled release of encapsulated compounds. A major function of a delivery system is to provide a protective environment to the encapsulated ingredient against the gastrointestinal digestion and optimal interaction with different biological fluids. The increase demand of nutritional supplements in foods originates partly from a lack of understanding of the gastrointestinal degradation of food systems and hence, there is a need to specifically address this issue in the design of LNCs. In this work, we characterize different shells of LNCs to encapsulate curcumin. We address specifically the impact of digestive steps to demonstrate that interfacial conformation and interactions of the different components in the shell allows tailoring the degradation of the nanocapsule which can then be rationally designed to deliver different functionalities of the LNCs. Interfacial engineering of nanoemulsions provides a route to improve the bioaccessibility of encapsulated curcumin at different stages in the gut.

Spruce Galactoglucomannan Stabilizers: Effect of Their Characteristics on Stability and Rheological Properties of Emulsion

Minh Thao Ho

University of Helsinki, Finland

Abstract:

Wood hemicelluloses (WHs) are abundant but remain largely underexploited. Development of their value-added applications is thus needed to ensure the feasibility of forest-based biorefining. WHs have the potential to be used as sustainable hydrocolloids to stabilize emulsions for a wide range of applications in chemical, pharmaceutical, food and cosmetic industries. However, the impact of their physicochemical properties towards their ability to stabilize emulsion is not yet fully understood. In this study, we explored stability and rheological properties of model emulsions (5% hexadecane and 1% stabilizer, w/w) stabilized by five types of spruce galactoglucomannans (GGMs), compared to established cellulosic stabilizers (methyl cellulose, MC; carboxymethyl cellulose, CMC; anionic cellulose nanocrystal, aCNC; and desulfated non-ionic cellulose nanocrystal, dCNC) to reveal possible emulsion stabilization mechanisms of GGMs. The high-acetyl (ha-) and low-acetyl (la-) GGM extracts, obtained by pressurized hot water extraction, were spray-dried (high-lignin ha-sGGM and la-sGGM), purified by ethanol precipitation (low-lignin ha-eGGM and la-eGGM), and carboxymethylated (CMGGM). The results indicated that among GGMs, emulsion prepared from CMGGM had the highest stability, while partial deacetylation and lignin removal markedly reduced emulsion stability of GGMs. CMGGM was unable to stabilize emulsion as well as CMC and aCNC, despite having similar zeta potential values. The viscosity values of GGM emulsions were similar, and much lower compared to cellulose-stabilized emulsions. Flow sweep measurements of emulsions with increasing and decreasing shear rate revealed that ha-eGGM and CMGGM behaved similarly to MC and CMC while la-sGGM, la-eGGM and ha-sGGM were similar to aCNC and dCNC.

Adsorption Kinetics and Interfacial Rheology of Whey Protein Isolate at Oil-Water Interfaces: Effects of Protein Concentration, pH, and Heat Treatment

Beibei Zhou

Teagasc Food Research Centre, Ireland

Abstract:

The interfacial pressure and shear rheological properties of whey protein isolate (WPI) at sunflower oil/water (o/w) interfaces were characterized using a pendant drop tensiometer and a rheometer equipped with a Du Nöuy ring. The impacts of bulk protein concentration Cp, pH (3 and 7) and heat treatment (unheated and 95 °C for 30 minutes) on WPI-stabilized o/w interfaces were investigated. Increasing Cp facilitated faster migration and unfolding of whey proteins at the interfaces. The elasticity of WPI adsorbed films increased with Cp (<0.1 wt%). A further increase in Cp (to 1 wt%) led to weaker interfacial films due to monolayer collapse and formation of multilayers. The rate of WPI adsorption was faster at pH 3 than pH 7. However, the interfacial film was weaker and less elastic at acidic pH than at neutral pH. Heat treated WPI became more surface active. Heat-enhanced surface activity was greater at pH 7 compared to pH 3, which may be associated with greater heat stability and less extensive increases in surface hydrophobicity. After heat treatment, WPI stabilized films became more elastic with longer relaxation time. This study extended current understanding of the interfacial properties of mixed whey protein system under different solvent and processing conditions. Such knowledge can contribute to fine-tune the complex conditions to improve product quality and to better understand the stability of dairy emulsions during subsequent processing, digestion or storage.

Propolis Nanoparticles Offering Pickering Stabilisation and Antimicrobial Activity onto O/W Emulsions

Nelli Chourmouziadi Laleni

University of Birmingham, United Kingdom

Abstract:

A clear consumer preference towards formulated products that utilise natural active species, has been generating significant industrial interest. One such natural component is propolis which is made by honeybees for healing and antiseptic purposes and has been associated with antibacterial, antifungal and antioxidant functionalities. However, propolis has limited aqueous solubility which restricts its use in industrial formulations. The present study demonstrates that aqueous dispersions of propolis nanoparticles (formed by sonication of propolis extracts in water) possess enhanced antimicrobial activity. This functionality can be 'transferred' into oil-in-water (O/W) emulsions, by using the propolis dispersions as the continuous phase in these systems. It was revealed that antimicrobial activity is linked to the mass fraction/concentration of propolis, the duration of sonication and the final dimensions of the formed nanoparticles. Emulsion droplet size and stability were also investigated, for different oil and surfactant fractions. The role of the propolis nanoparticles in the interfacial stabilisation emulsions was studied via dynamic interfacial tension measurements and imaged using fluorescent microscopy. It was revealed that propolis nanoparticles exhibit some affinity for the emulsion interface (Pickering-like functionality) which can provide complete emulsion stabilisation either by itself (at low oil contents) or synergistically in tandem with low concentrations of small molecular weight surfactants. Future research efforts will focus on the mechanism by which the Pickering functionality of the propolis nanoparticles arises and enhancing its magnitude. The ultimate goal would be to utilise these propolis colloidal species as natural ingredients offering both stability and antimicrobial activity to industrially relevant emulsion formulations.

Session IV Functional Foods & Functionality

Suppressive Effect of Fermented Brown Rice and Rice Bran on Spontaneous Type 1 Diabetes in NOD Mice

Keiko Kataoka

University of Tokushima, Japan

Abstract:

Type 1 diabetes is an autoimmune disease caused by Th1-mediating immune attack for pancreatic islets, and chronic pancreatic inflammation induces death of islet cells and depletes insulin secretion, resulting in onset of diabetes. In addition to genetic and immunologic factors, environmental factors such as infection and diet and could contribute to the pathogenesis. Brown rice and rice bran fermented by Aspergillus oryzae (FBRA) is a processed food that is rich in partially digested fiber and rice bran-derived bioactive components such as phytic acid and polyphenols. Anti-inflammatory effects of FBRA have been reported in several animal disease models. Then, we examined a suppressive effect of dietary administration of FBRA against spontaneous onset of type1 diabetes in NOD female mice. While control diet-fed mice showed glucosuria and hyperglycemia at around 20 week of age, the onset of these diabetic features was significantly delayed in 0.5% FBRA-fed group. FBRA-fed mice at 30 weeks of age kept higher ratio of intact islets and showed significantly lower insulitis score compared to the control diet group. Percentage and number of CD4+ IFN + T cells in the spleens and pancreatic lymph nodes at 12 weeks of age were not significantly different between control and 0.5% FBRA-fed group, consistent with the results in adoptive transfer experiments. These results suggest that dietary FBRA delayed the spontaneous onset of diabetes probably through maintaining the number of intact islets in NOD mice. Ameliorating effects after the onset of diabetes and suppressive mechanisms of FBRA should be further examined.

Seaweeds and Marine Animals as Protein Sources: Generation of Hydrolysates and Characterisation of Bioactivities, Iodine Content and Protein Digestibility

Maria Hayes

Teagasc Food Research Centre, Ireland

Abstract:

Seaweeds, also known as sea vegetables, and marine animals like starfish are consumed regularly as part of the Asian diet. The popularity of seaweeds in Western society is growing and they are now found as ingredients in breads, cookies and other food products. However, the rigid cell wall of seaweeds and the ossicles or exoskeleton of starfish limit applications of both as protein sources. Starfish are considered a pest in the production of mussels. The aim of this work was to quantify the protein, ash, lipid and fiber content of five different seaweeds and starfish. Following characterisation of the biomass, an enzymatic hydrolysis process was designed and employed to increase the protein content and bioavailability of proteins obtainable from these marine resources. The in vitro protein digestibility amino acid score (k-PDCAAS) method was used. Selected hydrolysates were then screened for their ability to inhibit enzymes important in the control of salt-water balance and blood pressure – namely Angiotensin-I-converting enzyme (ACE-1; EC 3.4.15.1) and renin (EC 3.4.23.15). Furthermore, the ability of the hydrolysates to inhibit Dipeptidyl peptidase IV (DPP-IV EC 3.4.14.5 was also determined. The content of iodine in biomass and hydrolysates was quantified, as this is an important consideration in the development of food products. Results indicate that both seaweeds and starfish have potential for use as functional food ingredients with health benefits that go beyond basic, human nutrition.

Development of Pumpkin-Based Beverage Fermented by Mature Coconut Water Kefir Brew Using Response Surface Methodology

Koh Wee Yin

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Abstract:

The development of fermented pumpkin-based beverages using mature coconut water kefir brew as starter culture enables valorisation of pumpkin fruits (which are prone to brown discolouration and microbial spoilage) and mature coconut water (usually treated as waste by coconut kernel industries). Box–Behnken design was employed to optimise the fermentation temperature and ingredients (pumpkin puree and brown sugar) in order to produce pumpkin-based beverages fermented using mature coconut water kefir brew (PWKC) that have good overall sensory acceptability, high viability for lactic and acetic acids bacteria and yeast, ethanol content within Halal permitted level (less than 1%, v/v), and short fermentation time. Optimisation study using response surface methodology was performed to the fermentation temperature and ingredients and the optimum condition obtained was: fermentation temperature at 32°C, pumpkin puree of 28% (w/v), and brown sugar of 8% (w/v). Optimised PWKC showed good overall sensory acceptability (6.95) with desirable viable cells of lactic and acetic acids bacteria and yeast (13.52, 10.00, and 9.50 log CFU/mL, respectively), ethanol content of 0.8% (v/v), and fermentation time of 22 h. Hence, mature coconut water kefir brew has the potential to be a suitable inoculum to ferment pumpkin-based beverages that serve as alternative delivery systems for probiotic.

In-Vitro Digestion Nullified the Differences Triggered by Roasting in Phenolic Composition and α-Glucosidase Inhibitory Capacity of Coffee

Marilisa Alongi

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Abstract:

Several plant-based foods, including coffee, may prevent type 2 diabetes due to their capacity to inhibit α-glucosidase. This is a hydrolase located in the intestine responsible for glucose release from oligo- and disaccharides, and its inhibition currently represents the most common therapeutic approach to reduce postprandial hyperglycemia. This study aimed to investigate the effect of roasting on the ability of coffee to inhibit α-glucosidase after in vitro digestion and to gain an insight into the compounds potentially involved in such an activity. Coffee beans were roasted to medium, dark and very dark degrees, and their brews were in vitro digested and tested for α-glucosidase inhibition. Phenolic acids (PA) and Maillard reaction indices (MRI) were quantified before and after digestion. Molecular docking was carried out to investigate α-glucosidase potential inhibition mechanisms. In vitro digested coffee inhibited α-glucosidase more effectively, compared to undigested samples, but no differences were observed among roast degrees. The inhibitory effect may be attributed to chlorogenic acid (CGA), which was the most abundant PA in digested coffees. In fact, molecular docking identified CGA to possess the highest affinity for α-glucosidase among the phenolic compounds studied. Even though digestion nullified roasting-induced differences in α-glucosidase inhibition, CGA showed a decreasing trend upon digestion. Similarly, MRI did not differ among coffees upon digestion but decreased compared to undigested samples. Results suggest that while CGA may play a role in this bioactivity, other compounds either already present in the coffee matrix or generated through digestion may contribute to this putative anti-diabetic effect.

Protective Effects of Cabbage Seed Extract on Muscle and Brain in Accelerated Aging Rodent Model

Debora Esposito

North Carolina State University, United States

Abstract:

Brassinosteroids (BRs) are a group of phytohormones that are responsible for regulating essential processes in plants including growth, development, and immunity. Their properties are often utilized in agriculture to enhance crop yield, improve crop quality, and reduce pesticide toxicity. Since cabbage seeds are a rich source of BRs, an investigation into the effects of a diet supplemented with cabbage seed extract was performed to evaluate the physical fitness of an accelerated aging mouse model. Food intake, body weight, body composition, and physical endurance were monitored throughout the procedure. Muscle tissue was harvested for gene expression analysis in order to identify biomarkers associated with satellite cells and the genes associated with myogenesis. Diets with low fat, high fat and supplementation with cabbage seed have effects on 18 mineral contents and 5 inflammatory cytokines in male and female mice brain were also determined. Animals treated with the cabbage extract diet exhibited a significant increase in satellite cell and myogenic marker expression in the gastrocnemius muscles. Cabbage seed diet down-regulated gene expression of COX 2 and IL6 at 32 weeks. These results suggest that a diet in BRs may contribute to improved physical fitness, skeletal muscle regeneration, brain protection in aging mice, and additionally may serve as a possible therapeutic option for the age-related muscle atrophy and reduced strength observed in sarcopenia.

Development of Polyphenol-Rich Berry Fruit Beverages and their Effect on Hepatic Steatosis in Obese Rats

Iza F Pérez-Ramírez

Autonomous University of Querétaro, Mexico

Abstract:

Functional beverages global market was about $130 million USD in 2019 and has a CAGR of 6.96% from 2021 to 2026. Natural botanical infused drink was one of the segments that dominated the functional beverages market in 2020. Therefore, we developed hypocaloric beverages elaborated with whole berry fruits with sensory attributes attractive to consumers and a rich polyphenol profile. Then, we evaluated their health beneficial effects in a murine obese model. The strawberry, blueberry and strawberry-blueberry blend beverages prevented the development of hypertriglyceridemia and hepatic steatosis in high fat and fructose diet-fed rats. Interestingly, the strawberry beverage increased the triglyceride fecal excretion and exhibited the greatest in vitro lipase inhibitory activity. These results demonstrate that the strawberry beverage decreased intestinal triglyceride digestion and/or absorption. Moreover, all beverages modulated the hepatic lipid metabolism via different mechanisms. The strawberry beverage showed the greatest effect on the down-regulation of key genes involved in lipogenesis (Acaca and Fasn) and the up-regulation of genes involved in fatty acid beta-oxidation (Cpt1a and Acadm), whereas the blueberry beverage showed the greatest effect on the down-regulation of genes involved in fatty acid intracellular transport (Fatp5 and Cd36). Therefore, we demonstrated that low-calorie beverages elaborated with whole berry fruits prevent the development of hypertriglyceridemia and hepatic steatosis, which are comorbidities associated with obesity.

The Advantages of Using *Scutellaria baicalensis* and Its Favonoids for the Management of Non-viral Hepatocellular Carcinoma

CHEN Minting

Hong Kong Baptist University, China

Abstract:

Scutellaria baicalensis Georgi is functional food and potential therapeutics for liver cancer. Among all the primary liver cancer, hepatocellular carcinoma (HCC) is the most common sub-type. The non-viral causes of HCC include diabetes mellitus (DM), non-alcoholic fatty liver disease (NAFLD), obesity, alcohol consumption and smoking. All these non-viral causes have pathogenic effects on HCC. Bioinformatics studies show that *S. baicalensis* acts on different targets in a complex signaling network in HCC. Experimental studies also suggested *S. baicalensis* and its flavonoids not only possess anti-HCC effects, but also alleviate the pathogenic conditions that are associated with the non-viral risk factors such as hepatic steatosis, NAFLD, DM and obesity. Therefore, *S. baicalensis* and its flavonoids have an advantage for the management of non-viral HCC. This review comprehensively summarizes the clinical application, therapeutic effects, mode of action at molecular levels and the safety of S. baicalensis and its flavonoids in HCC treatment.

Microgreens from *Pennisetum typhoides*: Functional Foods with Opportunities for Novel Research

Ratnika Sharma

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Abstract:

Millets are a subsistence crop that can grow on marginal land, yet they are not lacking in nutritional properties compared to popular cereal crops. Millet grains such as Pennisetum typhoides are rich in non-nutrient compounds such as phenolic acids, flavonoids, tannins, phytates etc. Protective effects of millet grains phenols include preventing oxidative stress, cancer and tumor progression. The present study focuses on anticancer activity of the identified phenolic acid from microgreens of *P. typhoides* by targeting Adenylosuccinate lyase (ADSL) in silico. ADSL plays an important role in controlling the cellular metabolism and replication by catalyzing de novo biosynthesis of purines in humans. It has been found to be linked with malignancies such as breast cancer and colon cancer. Initially, the growth of young leaves from *P. typhoides* was optimized for accumulation of maximum bioactives. Sequential extraction of eighth day post germination leaves with organic and polar solvents (petroleum ether, dichloromethane, methanol and water) revealed the differential antioxidant and prooxidant activities of these extracts. Additionally, antibacterial assays highlighted the potential of aqueous extracts which may be attributed to presence of phenolic compounds identified using UFLC. In silico studies to predict the interaction with ADSL presented the formation of hydrogen bonds and hydrophobic interactions between tested phenolic acid and active site residues formed by three chains of the heterotetramer protein. Also, binding energies were comparable with 5-fluorouracil, a pyrimidine analog and chemotherapeutic agent. Hence, microgreens of *P. typhoides* can be further proposed as novel source of these bioactives with multiple potential.

Evaluation of Belgian Endive Dietary Fibre Concentrate in Plant-Based Food Prototype Products

Anna Twarogowska

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Abstract:

The growing environmental and nutritional awareness of consumers who look for more sustainable, plant-based products, with clean labels, creates new challenges for the food industry. The need for natural food ingredients with high nutritional benefits such as high dietary fibre content and functional properties such as water holding capacity (WHC), oil holding capacity (OHC) and oil holding capacity, swelling capacity (SWC) opens up opportunities to use underutilized by-products and waste fractions as raw material for the development of new ingredients, products and applications. The dietary fibre concentrates (DFC) obtained from forced roots (by-product) of Belgian endive

were characterized by a high content of total dietary fibre (82.22 g/100 g DW), low caloric value, neutral taste and excellent functional properties: WHC of 15.15 g water/g DW, OHC of 3.85 g oil/g DW and SWC of 22.65 mL/g DW. Different concentrations (5-40%) of DFC were used in an all-in-one veggie burger mix as a functional ingredient to increase dietary fibre content and improve sensory and technological characteristics of the end product. The results showed that the DFC could be implemented in the plant-based burger mix formulation, resulting in an improved texture profile. The results showed that DFC produced from forced roots of Belgian endive is a promising food ingredient that can be used in food applications and positively impact its texture and nutritional value.

Mycoprotein Structure Influences Carbohydrate and Lipid Digestion *In vitro*

Raffaele Colosimo

Quadram Institute Bioscience, United Kingdom

Abstract:

Mycoprotein is a food ingredient used in meat-alternative products formed from the fermented biomass of the filamentous fungus Fusarium venenatum. Product texture stems from the presence of intact fungal cells. Clinical trials have shown improved glucose and lipid homeostasis after mycoprotein consumption compared to a control meal. This study aims to understand the biochemical mechanisms underlying the reduced serum lipid levels and insulin/glucose physiological responses promoted by mycoprotein. The digestion of starch or oil (emulsion) in the presence of mycoprotein was determined during simulated intestinal digestion (INFOGEST protocol) to understand how the mycoprotein matrix impacts carbohydrate and lipid digestion, respectively. The binding of bile salts was assessed by an in vitro assay following simulated intestinal digestion. Confocal-scanner-laser-microscopy was performed to investigate the diffusion of the enzyme -amylase into the mycoprotein matrix. *In vitro* digestion showed that starch digestion was reduced in the presence of mycoprotein. Confocal-laser-scanning-microscopy showed that fluorescently-labelled-amylase diffused through cell walls into the intact mycoprotein filamentous cells, thus reducing starch digestion. Similarly, the digestion of oil (emulsion) was reduced by mycoprotein. The bile salts binding was promoted by mycoprotein previously exposed to gastric acid pH or by isolated mycoprotein proteins. These findings are relevant to understanding the mechanisms by which mycoprotein can attenuate postprandial glycaemia/insulinemia and serum lipids. The mycoprotein matrix appeared to interact with digestive components, such as enzymes and bile salts, and reduce the nutrient bioaccessibility and digestion. A slower and sustained digestion promoted by mycoprotein may explain the improved physiological responses observed *in vivo*.

Sourdough Fermentation as a Tool to Enhance the Nutritional and Functional Features of *Tritordeum* Bread

Kashika Arora

Free University of Bolzano, Italy

Abstract:

Traditional sourdough fermentation of Tritordeum flour was characterized for its microbiological, biochemical, and nutritional properties. Viable plate counts of presumptive lactic acid bacteria, the ratio between lactic acid bacteria (LAB) and yeasts, the rate of acidification, biochemical features, the number of operational taxonomic units (OTUs), and diversity indices by 16S and 26S gene sequencing of sourdough, altogether demonstrated the maturity of the sourdough during 10 days of propagation. Although members of the phylum Firmicutes were present at very low or intermediate relative abundances in the flour, they became dominant after 1 day of propagation. LAB were almost exclusively representative of the Firmicutes by this time. Weissella confusa already dominant in Tritordeum flour and stably persisted, though it was later flanked by facultative heterofermentative LAB (e.g. Lactoplantibacillus plantarum). Yeast diversity was consistent throughout the sourdough propagation with Saccharomyces cerevisiae as the dominant population. The Tritordeum bread prepared with sourdough had improved digestibility in vitro in comparison to baker's yeast bread as demonstrated by changes in gut microbiota by 16S metagenome sequencing and

metabolomic profile by NMR analysis dominated by short chain fatty acids (SCFAs). Overall, this study revealed the potential of sourdough fermentation by the exploitation of a sustainable cereal.

Session V – Food Technology

Novel Applications of Quorn Fermentation Co-Product Extracts as Oil-Lowering Emulsifiers and Partial Egg White Replacers

Julien Lonchamp

Queen Margaret University, United Kingdom

Abstract:

This study assessed the functionality, composition and applications of a naturally-foaming co-product (centrate) from the Quorn fermentation process. A high molecular weight (HMW) fraction obtained via ultrafiltration of the centrate displayed high foaming, emulsifying and rheological properties. Large mycelium aggregates contributed to the high viscosity and to foam/emulsion stabilisation. In parallel tensiometry measurements showed that interfacially-active molecules formed a rigid film at the oil/water interface and a number of functional metabolites and proteins were identified in centrate, including a cerato-platanin protein, cell membrane/wall constituents and guanine-based nucleosides/nucleotides. This study then assessed the potential of HMW as egg white (EW) replacer and the modulation of its functionality by sonication for fat reduction purpose. HMW allowed for 25% EW replacement as foaming agent and 25% to 50% EW replacement as gelling agent. The large mycelium structures characteristic of HMW were reported in EW-HMW mixtures, contributing to their functionality. Sonication of a HMW solution led to the breakdown of these structures into smaller fragments and to smaller emulsion oil droplets. Micrographs suggested the possible contribution of these small fragments to oil droplet stabilisation. 50% oil-reduced HMW emulsions prepared by mixing HMW emulsions with sonicated HMW solutions displayed even smaller oil droplets. This study highlighted the potential of extracts from the Quorn process as novel sustainable functional ingredients for egg white and emulsion oil reduction. This work highlighted the complex nature of the centrate's functionality, with contributions from a broad range of components, and the potential to modulate the structure/functionality of HMW by sonication.

Macromolecular Properties Underlying Carrageenan Implications on Digestive Proteolysis, Bioaccessibility of Bioactive Peptides and Colonic Microbiota

Uri Lesmes

Technion - Israel Institute of Technology, Israel

Abstract:

Recently, EFSA panel suggested a temporary ADI for carrageenan (E407) (CGN) of 75 mg/kgBW/Day with children identified as high consumers of CGN. This talk will overview a set of studies underpining CGN macromolecular properties that delineate CGN impact on digestive proteolysis and the colon microbiome. Physicochemical properties determined by SEC-MALLS, DLS and rheology tests will be correlated to the attenuated digestive proteolysis of dairy proteins in children and adults. In vitro human digestions coupled with LC-MS proteomic analyses will highlight the links between CGN properties (electrophoretic mobility and degree of sulphation) to the breakdown of alpha-lactalbumin, beta-lactoglobulin and lactoferrin. Further, faecal batch cultures of freshly collected human feces (from 10 healthy individuals, age 25.7.4.2) and Illumina Miseq 16S rRNA sequencing establish an effect of CGN on microbiota composition diverting Firmicutes/Bacteroidetes ratio and reducing microbiota richness and evenness (Shannon index and Chao 1 index). Overall, this research will show

participants evidence establishing CGN charge and electrostatic biopolymer interactions as strong determinants for possible anti-nutritional effects of CGN in food systems.

Effect of pH Na^+ and Extractant on Emulsifying Properties of Soy Hull Polysaccharide

He Liu

Bohai University, China

Abstract:

Soy hull polysaccharide has the abilities of thickening and gelatinization, but emulsification is not demonstrated which limited its utilization. Two kinds of Soy hull polysaccharides were extracted with ammonium oxalate (SHPA) and sodium citrate (SHPS), their chemical properties, conformation, and the effects of concentration and environmental factors (pH and ionic strength) on the stability of SHPA and SHPS emulsions were investigated. Also, adsorption characteristics at the oil/water interface were characterized by means of cryo-scanning electron microscopy and dynamic drop analysis. The results of shows that the emulsifying activity and interface adsorption capacity of SHPS are better than SHPA without adjusting the pH value of the system. The emulsion is adding 0.9% SHPS can be stored for more than 30 d, which have the smallest and uniform particle size. Nevertheless, SHPA existed in the long chain intertwined at the oil/water interface which the network structure is not dense, and the SHPA emulsion was unstable. When the pH value of the emulsion was 3.0 and the salt ion concentration was 0.1 mol/L, the emulsifying activity, interfacial adsorption capacity and steric hindrance of SHPA were significantly enhanced. When the salt ion concentration exceeded 0.1 mol/L, the emulsion occurred flocculation. In conclusion, SHPS exhibited excellent emulsifying activity and stability, while SHPA can be used as an effective emulsifier in acidic O/W emulsion.

High Pressure Processing for Structure Modification of Meat and Milk Proteins

Vibeke Orlien

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Abstract:

High pressure (HP) technology has shown great promise for the modification of food proteins leading to changes in functional properties of processed food products. Thus, HP is a tool for structure modification of the major and important food class, meat and dairy products. For meat products a change in functionality of the proteins can be a tool to avoid unhealthy additives like salts. Salts enhance the solubility of the structural myofibrillar proteins, thereby affecting their ability to form a gel matrix. It is found that HP affects myofibrillar proteins, thus aiding or improving meat binding properties. However, using HP to induce texture modification is a delicate balance. On the one hand, HP increases the solubility of muscle proteins and improves the functional properties of certain proteins. On the other hand, HP may also induce protein denaturation and aggregation resulting in loss of solubility of the main proteins. In general, an important finding about pressure-induced meat gels is an improved water binding capacity. Dairy systems have been the subject of extensive studies concerning the HP-induced modification of structures. HP affects both casein micelle dissociation and whey protein denaturation. Pressurizing skim milk added whey protein and/or hydrocolloids produces milk products with textures ranging from yoghurt-like to pudding-like. Upon manufacturing, distribution, and storage of meat and milk gel products the important gel characteristics, gel elasticity and water holding, must be controlled. Exactly these parameters are found to depend on and can be modulated by pressure level, duration, and concentration of proteins or ingredients.

Tailoring Functionalities of Plant-based Foods: Fermented Dairy Alternatives

Rene Floris

Division Manager FOOD, NIZO, Ede, Netherlands

Abstract:

The protein transition is massively diversifying the range of proteins available to ingredient and food product manufacturers. Alongside the traditional animal-based sources – meat, eggs, milk – we now have many different plant-based alternatives including legumes like soybeans, peas and chickpeas, as well as maize, potatoes and oilseeds. More options are appearing all the time, from emerging sources including fava beans (also called faba or broad beans) and green leaves to future possibilities such as microalgae and proteins from single-celled organisms produced by fermentation. Obviously, each protein source has its pros and cons and, when you are starting to develop a new plant-based product, understanding and evaluating them can seem an overwhelming task. But you can simplify the process by thinking about four basic considerations. The development of plant-based dairy alternatives, especially fermented dairy alternatives are of great interest for the consumers nowadays and therefore for the food industry. Fermentation is a very powerful technology to help improving and optimizing the flavour and texture of plant-based (fermented) foods. In this lecture the role and properties of various commercially relevant plant proteins in relation to food products will be discussed as well as the interplay of food fermentation with these proteins in food (fermented) food products.

Plant Proteins – Processing and Nutritional Quality

Iben Lykke Petersen

University of Copenhagen, Denmark

Abstract:

This talk will focus on plant protein ingredients from seeds (mainly legumes), with emphasis on how different processing techniques affect the nutritional quality of these plant protein ingredients. Processing covers both the processing techniques applied to extract the plant proteins from the seed raw material using both dry fractionation and wet extraction techniques, and post-processing such as cooking and extrusion. The nutritional quality has been evaluated by the level of specific antinutrients as well as the protein digestibility. The antinutrients in focus are the ubiquitous trypsin inhibitors, as well as the glycosides vicine and convicine found in faba beans. Galactooligosaccharides, posing a problem to individuals suffering from irritable bowel syndrome (IBS), are also included. Protein digestibility has been assessed with an in vitro protein digestibility (IVPD) static assay, covering both gastric and intestinal phases.

Soybean Okara Byproduct: Physicochemical and Conformational Changes Induced by Ultrasound-Driven Protein Extraction

Gilda Aiello

The San Raffaele University of Rome, Italy

Abstract:

Soybean is a protein-rich oilseed widely employed in the food industry for producing soy foods and beverages. Thanks to its nutrient content, soybean is used in several dishes as a valid alternative to meat, and it is added in various vegan-friendly food and beverages. However, the production of soy-based beverages produces tons of solid by-products named okara, which contain about 50% dietary fibers, 25% protein, 10% lipid, and other nutrients generally discarded or used as feed ingredient. Ultrasonication is actually reported to improve the extraction of proteins as well

as their functionalities. In this work ultrasonication, conducted at different temperatures (80 ˚C, 60 ˚C and 20 ˚C), was applied to enhance protein extractability. The changes in the protein profile, concentration, secondary and tertiary structure, hydrophobicity, solubility, antioxidant capacity, and rheological and morphological features were evaluated in comparison with untreated soy okara protein. Increasing the temperature from 20 up to 80 ◦C greatly enhanced the yields and the protein solubility without affecting the viscosity. The protein secondary and tertiary structures were also gradually modified. After the ultrasonication at the highest temperature, a significant morphological transition from well-defined single round structures to highly aggregated ones was observed. The ultrasounds induced the release of peptides with consequent increase of antioxidant properties. Herein, the integrated strategy was applied in order to foster the okara proteins obtained after ultrasound extraction as high-quality products for new applications in human nutrition and to provide a more sustainable way to solve the environmental problem of the waste.

Active Polysaccharide Matrices for Extending the Shelf-life of Fresh Plant Products

Kirsi S. Mikkonen

University of Helsinki, Finland

Abstract:

Transportation and storage of fruits, berries, and vegetables is increasing to meet growing consumer demand for fresh foods. Foods are perishable biomaterials whose shelf-life can be remarkably extended by using active packaging. Active packaging not only protects its contents from the outside environment, but also interacts with the product, e.g., by releasing or absorbing active compounds. Hexanal, a safe volatile compound that also has antimicrobial properties is an active compound that slows down ripening and softening of plant tissues. Thus hexanal could be applied during the food distribution chain to slow down the spoilage of plant-based products and reduce food waste. Nonetheless, due to the rapid evaporation of hexanal, a constant supply is needed. We present an innovative concept to incorporate food-grade sunflower oil emulsified in a spruce galactoglucomannans (GGM) polysaccharide matrix for controlled in situ production and release of hexanal. We compared enzyme catalyzed and light induced lipid oxidation reactions for the production and release of hexanal at different environmental conditions, and evaluated the concept with storage stability tests of fruit, berries, and cherry tomatoes. The effect of matrix storage temperature and relative humidity on the release of hexanal and other volatile products will be discussed. The lipid-loaded matrices assessed here are a potential novel delivery matrix for controlled hexanal release to extend the shelf life of plant-based products.

Protein Structural Changes and Physical Parameters of Abalone *(Haliotis rufescens)* Muscles Treated by High Hydrostatic Pressure

Yamira Cepero Betancourt

University of the Bío-Bío, Chile

Abstract:

The effect of high hydrostatic pressure (HHP, 200-500 MPa for 5 min) treatments on the modifications in protein secondary structure and textural and rheological properties of abalone muscles was evaluated. Protein structural changes in isolated proteins (myofibrillar and collagen) and whole muscle proteins were analyzed by FTIR spectroscopy, DSC, and SDS-PAGE. Textural and rheological properties were determined in abalone muscles by compression and oscillatory shear tests and scanning electron microscopy. Protein structural changes in myofibrillar proteins involved unfolding 3_{10}-helix and β-sheet structures followed by the formation of additional β-turn and random coils. Protein unfolding occurred in collagen at 200 MPa and protein aggregation at 400 and 500 MPa. In whole muscle proteins, partial denaturation appeared through transitions from intermolecular β-sheet into intramolecular β-sheet structures. In addition, HHP treatments affected collagen less than myofibrillar proteins based on temperature denaturation and electrophoretic pattern changes. High β-sheet and lower random coil contents in isolated proteins could be correlated with high abalone muscle hardness. The HHP-treated abalone at

200 MPa had the least compact structure and lowest hardness value. Meanwhile, HHP at 400 and 500 MPa had a more compact structure when abalone muscle became harder. The HHP-treated abalone at 500 MPa exhibed the highest elastic component. Pressure-induced unfolded states in proteins reduced hardness ($p < 0.05$), whereas a more ordered protein structure improved the elastic behavior of abalone muscles. In conclusion, HHP causes structural changes in myofibrillar and collagen proteins that modify the textural and rheological properties of abalone muscles.

Evaluation of Non-Equilibrium Dynamic Changes in Food Structure to Manage Appearance, Functionality and Stability

Pilar Buera

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Abstract:

Most food components are preserved in states that are not thermodynamically stable. Therefore, a great technological challenge is to achieve the preservation of their desirable properties, which are governed by kinetic limitations, often determined by its amorphous state. The objective of this work was to analyze how thermodynamic and non-equilibrium aspects together with data on water dynamics are necessary to define process and stability conditions and also manage appearance aspects. Thermal transitions were analyzed by DSC, and 1H-NMR transversal relaxation times relaxation times, T2, chromatic parameters, transparency, FT-IR spectra and RX diffractograms were obtained to analyze chemical and physical modifications during storage of herbs and spices extract powders with antioxidant or antiglycant activities in trehalose or maltodextrin matrices. The modifications caused by glass transition were manifested in physical aspects and in the decrease in antioxidant/antiglycant capacities and were accentuated when the crystallization phenomenon occurred. The kinetic constants for the loss of bioactive encapsulated compounds stored in the glassy state were related to the kinetics of the enthalpy relaxations changes and reflected in the appearance. The study of movements at the molecular level facilitated the interpretation of thermal and mechanical properties, based on supramolecular interactions. Enthalpy relaxation phenomenon can be established as a criterion for defining storage conditions in systems that have to be stored in the glassy state. The combined tools may also help to control desirable product properties which play a decisive role in the design of innovative foods with defined characteristics.

Chemical Profile of Colorful Bean (*Phaseolus Vulgaris L*) Flours: Changes Influenced by the Cooking Method

Juliana Aparecida Bento

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Abstract:

This study aimed to determine how the cooking methods change the phenolics and saponins profiles, oligosaccharides, the antinutrients (phytate and tannins) and total phenolic content, and antioxidant properties of flours from beans with different colors (Artico (white); Embaixador (red); Jalo (yellow); and Realce (brindle)). The autoclave cooking consisted of 6h soaking and 5 min cooking (C5); and 20 min cooking without soaking (C20). Both cooking methods significantly promote alterations (reductions or increase of content) on the chemical compounds studied, and the intensity of these changes was affected by the cultivars. Most of flours of C5 beans presented a lower loss of anthocyanins (3.9-70.0%), DPPH (11.7-87.2%), ABTS (0.0-82.7%), and tannins (0.0-90.0%) compared with C20. The cooked flours of Artico and Realce showed some similarities among chemical compounds, as well as the lowest concentration of tannins (0.0 mg g-1), antioxidant activity (0.40 μmol Trolox g-1), and higher amounts of oligosaccharides and acetylcholine. The profile of phenolics showed that cultivar Jalo presented the highest content of kaempferol-O-hexoside. The cooked flours presented a reduction in phenolics and soyasaponins αg, and βg, and an increase in soyasaponins Ba and I. The oligosaccharides also increased with cooking (specifically for the flours of beans cooked for 20 min without soaking), except for Artico which presented good thermal stability. Finally,

it was possible to verify that the cooking methods promoted significant changes in the amount and the chemical compounds of different bean flours, with emphasis on the increase of phytate, some saponins, and oligosaccharides.

Modeling and Optimization of High-Pressure Homogenization of Not from Concentrate Juice: Achieving Better Juice Quality Using Sustainable Production

Jianing Liu

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Abstract:

Studies on the optimization of innovative and sustainable food processing on the comprehensive quality of clean-label fruit and vegetable juices are limited. The present work optimized high-pressure homogenization (HPH) parameters for not-from-concentrate combined peach and carrot juices, based on a two-step comprehensive model using factor analysis and analytic hierarchy process methods. Results revealed that HPH could retain concentrations of the bioactive compounds (carotenoids and polyphenols) in a combined juice compared with non-homogenization. Specifically, pressures over 200 MPa retained bioactive compound concentrations and increased antioxidant activities. Nutrition-oriented optimization, with higher judgement weight on nutritional properties, and sense-oriented optimization, with higher weight on sensory properties, were set up. Combined juice (250 MPa, 1 pass and 25 ˚C) had the best quality, based on the nutrition- and sense-oriented models. Back propagation neural network (BPNN) models could predict antioxidant capacities of the combined juice with greater accuracy compared with stepwise linear regression. The relative errors of BPNN prediction model were ≤ 5 %. This work broadens the application of multi-source data mining methods and provides valuable information for developing optimization and prediction models of clean label products using sustainable production processes.

Changes in Network Structure of Agarose during Gelation Studied by Multiple Particle Tracking Method and NMR

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Abstract:

The sol-gel transition mechanism of agarose has been a subject of interest due to the wide applications of the gel in biological and biomedical fields. In this study, the formation of aggregated structure and its heterogeneity during the gelation of agarose were observed. The mechanism was validated by particle tracking and the pulsed-field-gradient stimulated echo (PGSTE) 1H NMR methods. The particle trajectories and mean square displacement (MSD) of the probe particles exhibited two distinct behaviors of the particle movements, trapped and diffusive, even at a higher temperature than the gelation temperature, indicating a formation of nuclei of the aggregates. The number of trapped particles gradually increased, and the MSD of diffusive particles decreased on cooling. Self-diffusion coefficient (D) and echo signal intensity without gradient (I0) of agarose measured by NMR supported the information on the gelation mechanism of agarose at a molecular level. The decrease in I0 and increase in D indicated the formation of aggregated bundles. Furthermore, the effect of agarose concentration on the network changes during gelation will be discussed.

Food Aroma – The Latest Technologies to Identify the Chemistry of Smell

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Abstract:

Aroma is an important sensory factor in the perception of food. But what exactly makes a food smell pungent, or savory, or foul? The chemistry of aroma, or smell, can be very complex. There are an estimated 10,000 volatile compounds across all foods that can contribute to the specific smell of a given food. Yet only a few hundred determine the aroma of the food we eat. In this study, we developed a novel approach to identifying aroma compounds in foods. Using a combination of GCMS and GC-SCD (sulfur chemiluminescence detector) along with employing metabolomic techniques, we were able to identify and quantitate key aroma compounds in various foods and beverages. Samples include several aromatic beverages (beer, wine, spirits, and coffee) and foods (kimchi, soy sauce, and cheese).

On-Demand Food Manufacturing Through 3D Food Printing

Antonio Derossi

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Abstract:

The ambition of producing food on-demand addressing individual sensory desires or nutritional/ functional needs a goal for the future of food manufacturing. Also, the creation of foods capable to improve sensory enjoyment, solving individual problems, and/or modulating satiety is of great importance. Probably, the most important question, though, is how it would be possible to design and modulate the external and internal food properties. The candidate technologies should show enough degrees of freedom to control the food formulation and the structure-properties relationships. That said, 3D Food Printing (3DFP), perhaps, is the only technique showing potentials to address the above matters. It introduces the opportunity of translating a 3D digital model into a tangible food structure by a layer-by-layer building process of printable food formulas deposited through printing movements. However, the food materials are extremely more difficult to print than the thermoplastic materials (Derossi et al., 2021) and the last 10 years have been dedicated to the study of food printability (Derossi et al., 2020) and the optimization of the printing variables (Pulatsu et al., 2021). Differently, this contribution is primarily dedicated to the the creation of a programmable 3D food structure that, by placing voids and solids elements in appropriated positions, will open opportunities to get innovative food perceptions, to control satiety and to address mastication/swallowing problems. More precisely, we present our recent realizations by modulating the internal structures of cereal-based snacks and ink-gels and by using the microstructure of apple tissues as a digital model for 3D food printing.

Effects of Dietary Proteins from Different Origins on Intestinal Glucose Transport

Bennoit Cudennec

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Abstract:

Several studies conducted in rodents and humans have demonstrated that high protein diets improve glucose homeostasis. Nevertheless, the mechanisms underlying this effect remain elusive. It has recently been evidenced that peptides generated by bean protein hydrolysis induce a decreased glucose uptake in Caco-2 cells (Mojica et al. 2018), suggesting that the intestinal sensing of digested-derived proteins at the intestinal level could also modulate glucose transport. This transport mainly involves the Na+/glucose cotransporter (SGLT1) at the apical side of enterocytes and glucose transporter type 2 (GLUT2) at the basolateral side of enterocytes (Merino et al. 2020). Six dietary proteins from animal and vegetal origins were selected and digested in vitro. The digested proteins were able to decrease intestinal glucose absorption in vitro and ex vivo. Moreover, acute ingestion of casein and fish gelatin improved glucose tolerance in Wistar rats without significant effect on insulin secretion. In parallel, GLUT2 mRNA expression in enterocytes decreased following short-term incubation with some of the digested proteins. Thus, this study suggests for the first time that acute protein intake could improve glucose tolerance partly due to a lowering effect on intestinal glucose absorption.

Microfluidic-Based Tools to Assess the Efficiency and Safety of Engineered Nanomaterials for Food Applications

Catarina Gonçalves

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Abstract:

In vitro models representative of the physiological conditions of human digestion are essential for the development of new drugs and ingredients, or for testing new formulations for oral delivery, since their behaviour (changes and interactions) under the gastrointestinal tract determine their efficiency and safety.1 Several in vitro models (static or dynamic) with different complexities have been designed and explored.2 However, these models require relatively high volumes and therefore are not suitable for valuable samples. In addition, these devices are not reusable and thorough cleaning between usages is critical to avoid cross-contaminations. Microfluidics appears as a suitable solution to develop miniaturized models to simulate complex physiological systems allowing high reproducibility and throughput.3 Despite the extensive use of PDMS in microfluidic devices, its hydrophobicity and high porosity lead to the absorption and diffusion of small molecules into the elastomer matrix, altering the concentration of solutions and consequently affecting result interpretation. In the present work, independent PDMS microfluidic devices are proposed to study digestion (digestion-chip) and intestinal absorption (gut-chip). The effect of different factors (solute/solvent pairings, concentration, residence time) on the absorption of small fluorescent molecules by PDMS was explored. Different PDMS modifications (surface or bulk) were further tested. The digestion-chip was validated using a quenched, fluorescently-labelled casein derivative, as a test molecule. The subsequent interaction of digesta with intestinal epithelial cell lines was studied in order to avoid cytotoxicity due to the high level of digestive enzymes that compromise cell viability. The formation of a cell monolayer and its differentiation on-chip were assessed by immunofluorescence using confocal microscopy.

Session VI – Nutraceuticals and Nutrition

Probiotics and Panbiotics Balance the Food Uptake and Gut Defences

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Abstract:

In international studies, three basic types of the human digestive microbiome have been identified. They reflect the basic total structures and associations of the microbiota, as well as the main microbiological groups in connection with the main diet. These groups of the microbiome are associated with 1. The cereal-based diet consumers e.g. in Africa, 2. The western diet containing more meat and protein-rich foods, and 3. The Mediterranean and Far-Eastern or Japanese diet. In the local populations, it is possible to see the wide occurrence of some microbes. Since the microbiological communities strive for balance, it is possible to stimulate those microbes which have beneficial effects. If their role in the gut ecosystems is shared by a majority of individuals on the population level, these added strains could be called pan biotics. These kinds of microbiological entities could occur for the establishment of the Bacteriological Intestinal Balance based on the dualistic balance of the Enterobacteriaceae strains in the duodenum. The maintenance of these bacterial strains in vivo depends on the diet type locally and on the larger geographical areas. In this report, we demonstrate the treatments of the microbial gut flora with probiotic or pan biotic effector strains in order to maintain health on the individual and population levels. The latter could be demonstrated by studies on the patient microbiota in comparison with the flora of his or her district population. In individual cases, it is also possible to find potential treatments by investigating the microbiological and immunological balances in the patient samples.

Polyphenol Rich Extract Produced by Ohmic Heating of Vine Pruning Residue Has Anti-Colorectal Cancer Activity and Increases Sensitivity to the Chemotherapeutic Drug 5-FU

Cristina Pereira-Wilson

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Abstract:

The implementation of circular economy models and environmentally friendly bio-waste recycling methodologies will reduce the impact of the agro-food industry while allowing the sector's sustainable growth. The environmental friendly Ohmic heating method (80º for 60min) was used to produce a polyphenol enriched hydro-alcoholic extract from vine pruning residue (VPE). Chemical characterization of the extract showed the major constituents to be Apigenin (AP), Quercetin (Q), Ellagic Acid (EA) and Hesperidin (H). The anti-colorectal (CRC) cancer effects of VPE and of its main constituents were tested in the cell lines HCT116 and RKO. These cell lines are representative of two of the most common types of human colorectal cancer: HCT116 harbors a KRAS mutation and RKO a BRAF mutation. Effects on proliferation, cell cycle, and DNA damage were evaluated and RKO cells were more sensitive than HCT116 to VPE. The pharmaceutical drug 5-FU is extensively used in CRC treatment but resistance mechanisms reduce its efficacy. Therefore, the effects of VPE on cell sensitivity to the chemotherapeutic 5- FU were tested and the data shows that VPE increased the response to 5-FU both decreasing cell proliferation and increasing apoptotic cells death. The effects were observed in both cell lines but RKO seemed more sensitive to the effects of VPE alone and in combination with 5-FU. Of the individual compounds tested, AP and H were the most effective of the major constituents. However, the extract showed superior activity relative to any of the constituents used alone.

Isolation and Molecular Identification of Lactic Acid Bacteria from *D.sap*, A New Grape Fermented Solution

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Abstract:

Traditional grape vinegar is a popular condiment in Iran. Vinegar contains lactic acid bacteria, acetic acid bacteria and yeast. Lactic acid bacteria improve the flavor of vinegar. According to the US Food and Drug Administration, vinegar is a solution that contains at least 4% acetic acid. But, the subject studied in this article is a grape vinegar-like solution containing 2.5% acetic acid and 1.1% lactic acid because the production process is different from vinegar. This study was aimed at isolating and identifying Lactic acid bacteria from the solution. 16s rRNA gene sequencing was performed to identify the lactic acid bacteria isolates. The bacterial isolates were identified as Lactobacillus parakefiri and Lactobacillus hilgardi. Lactobacillus parakefiri were isolated from kefir grains for the first time. In the present study, we report for the first time the Lactobacillus parakefiri isolated from vinegar-like solution.

The Effect of Aromatic Rice (Joha) Phytonutrient(S) in High Fat High Carbohydrate (HFHC) Diet Induced Insulin Resistance *In Vivo* Model System

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Abstract:

Rice *Oryza sativa* constitutes a special part of human diet specially in Asian cuisine. Amongst the 40,000 rice varieties the aromatic rice holds a special position worldwide. One such scented rice variety is Joha rice. Joha rice is

a short grain scented winter paddy prevalent for its great aroma and/or equally noteworthy taste, and has a premium value in national as well as in international market. Previous biochemical and target based LCMS analysis have identified different phytonutrients in scented rice seeds. The HRMS and MSMS spectral data analysis recognized the two compounds as essential fatty acid linoleic (C-18, ω-6 fatty acid) and linolenic (C-18, ω-3 fatty acid) acid. Thus, an in vivo study was designed to see the effects of scented rice extract on wistar rats fed on High Fat High Carbohydrate (HFHC) diet. The results from a 24 week long study revealed decrease in the blood glucose levels in the scented rice treated group. The result from serum biochemical analysis showed that Joha rice has significant triglycerides, LDL, cholesterol lowering capacity. Also the results from liver enzyme analysis showed significant AST/ GOT and ALT/ GPT levels in treated groups. Further, molecular signaling was screened in the Akt/PKB pathway by targeting downstream proteins as Akt, p-Akt, Gsk-3β, GLUT4. The results showed significant increase in GLUT4 indicating serum glucose uptake. The inflammatory markers IL-6, IL-10, IL-1β were also analyzed and found potent in the treated group against diabetic group. Thus, Joha rice has promising anti diabetic potential and helps promisingly as a nutraceutical for patients with metabolic syndrome.

Tryptophan Fluorescence and Functional Properties of Whey

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Abstract:

The use of whey proteins is increasing in the food industry due to a wide range of functional and nutritional benefits. However, the properties of whey are affected by heating. Tryptophan front-face fluorescence (FTrp, excitation at 290 nm and emission range 300-450 nm) and functional properties of whey, i.e., gelation, foaming and emulsion stability, were studied after heat treatment of reconstituted skim milk powder enriched with whey protein isolate at 80 °C with seven holding times (0 - 30 min). Whey was obtained by isoelectric precipitation of caseins with HCl 1N. For gelation, samples were heated (at 90 °C for 1h), centrifuged and the resulting gel weighted. Foam overrun and draining were measured by whipping samples with a mixer. The Oil-in-water emulsions (25 % w/w) were followed for 30 min and assessed with the bottom Turbiscan® stability index (TSI). As expected, undenatured whey protein content of milk (UWP) and FTrp were significantly ($p < 0.05$) affected by heat. Functional properties correlated significantly ($P < 0.05$) with UWP especially after normalization with the total protein content of whey. Among the seven holding times, the percentage of gel formation was reduced significantly and TSI showed a decrease in emulsifying stability. However, heat significantly enhanced foam stability. Concerning FTrp, the intensity correlated with all functional properties studied. These results show that FTrp in whey allows detecting differences on the functional properties evaluated, thus, suggesting the potential of front-face fluorescence for prediction of the functional properties of whey.

Poster Presentations

P-01 Influence of Ultrasounds on Wine Microbiota

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Abstract:

Winemaking process involves numerous genera and species of yeast and bacteria, like *S.cerevisiae* who are responsible for carrying out the alcoholic fermentation; other non-Saccharomyces yeasts, who may or may not be present, for example, *Dekkera anomala* is a common problematic yeast in winemaking. Lactic acid bacterias are present during alcoholic fermentation in low population, however, it increases very significantly in malolactic fermentation

to decrease again in the finished product. The aim of this work was to study how different ultrasound treatments affect the vitality and viability of some of the characteristic microorganisms of wine: *Lactobacillus plantarum* and two different species of yeast, Saccharomyces cerevisiae and Dekkera anomala. Six different treatments were applied to fresh crops with a population of 106 cfu/mL, varying the conditions of exposure time, power and the use or not of electric pulses. To study the effect on viability, plate counts were carried out, while the variation in vitality was quantified by obtaining the kinetic parameters of the microorganisms after each treatment. The mediums used were MRS and YPD for bacteria and yeasts respectively. In each case, in parallel, a positive control without application of ultrasound was used. The results showed that on some occasions the treatments had an effect on vitality or even increased it slightly; in others, the microbial metabolism was attenuated, which is mainly reflected in an increase in the latency phase and loss of viability. Finally, only one of the applications characterized by using the highest power and not using pulses, was able to destroy all the microorganisms.

P-02 Application of NIR Spectroscopy for Estimating Density, Polyphenol Content and Antioxidant Capacity of Natural Cork Stoppers

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Abstract:

Research has been carried out on the use of NIR technology for the determination of physical and chemical parameters of natural cork such as density, polyphenol concentration and antioxidant activity. For this, 132 samples of natural cork stoppers were used, from which the spectra was obtained in the near infrared range (800-2500 nm) using a FT-NIR spectrophotometer Bruker model MPA II. Two-thirds of the samples were used to develop partial least square (PLS) calibration equations, and the remaining one-third for the external validation of these PLS equations. The OPUS / QUANT software was used. The results obtained showed that it is possible to correlate the density, concentration of polyphenols and antioxidant activity with the NIR spectrum of the samples, showing all the PLS equations satisfactory values of their statistical parameters. So, for calibration equations, factors were between 6-9, coefficient of determination (Rc2) between 60.32-72.04, standard error of calibration (SEC) between 3.55-12.50, and the ratio of performance to deviation (RPDc) between 1.59-1.89. Showing regression lines and its coefficients, slopec was between 0.603-0.720 and coefficient of correlation (rc2) between 0.7767-0.8487. For equations of external validation, results were similar, like Bias between 0.39-1.81, standard error of validation (SEP) between 5.04-14.10, RDPv between 1.11-1.54, slopev between 0.606-0.659 and rv2 between 0.6202-0.7767. The best NIR calibration was the antioxidant activity model while the worst was the density one. Therefore, NIR spectroscopy can be used as a rapid and non-destructive technique for the simultaneous determination of the parameters studied in the industry dedicated to the manufacture of cork stoppers.

P-03 NADES-based Surfactant-Free Microemulsions for Solubilization and Extraction of Curcumin from *Curcuma longa*

Verena Huber

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Abstract:

Natural Deep Eutectic Solvents (NADES) are a new class of non-aqueous solvents. They are eutectic mixtures of naturally occurring, often hydrophilic hydrogen bond donors and acceptors, which exhibit a low melting point as compared to their single components. Through their desirable solvent characteristics, like low melting point and volatility, combined with high stability, solving capability, and biocompatibility, they can be considered an attractive, green alternative to common solvents. Choline chloride-based NADES were used as adjuvants to ethanol/triacetin mixtures to obtain ternary systems with a superior solubility of curcumin (2 to 5-fold increase) compared to previously studied water-based surfactant-free microemulsions (SFMEs). An easy and fast room temperature extraction

procedure was applied, extracting up to ~ 80 % of the total curcuminoid content of ground rhizomes of *Curcuma longa L.* The high solubility of curcumin in the solvent systems allowed multiple extractions of fresh rhizomes in the same solvent until saturation. While using the same amount of solvent, even more concentrated curcuminoid tinctures could be achieved when using the ternary NADES systems as compared to the aqueous SFMEs.

P-04 Role of Bile Salt in Lipid Digestion Process

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Abstract:

Bile salts (BS) are responsible for stimulating the lipid digestion process in our organism. Understanding the role of BS in lipolysis, is crucial in controlling the calorie uptake. To determine the importance of the form of the BS in our gastrointestinal track and its influence on digestion process, two structurally distinct BS: sodium taurocholate (NaTC) and sodium deoxycholate (NaDC) and at various mixing ratios were investigated. Interfacial tension measurements were used to determine the potential of the BS to reduce droplet size and its ability to adsorb and desorb from the oil interface. The lower surface tension exhibited by NaDC may indicate stronger potential of lipase/colipase to adsorb, which may therefore facilitate the lipolysis process. Na TC exhibited a higher surface tension which would indicate faster desorption from the oil interface and removal of lipolysis products from the oil interface. Furthermore, critical micelle concentration (CMC) was measured by conductivity. The interaction between NaTC+NaDC surfactants revealed that unconjugated forms of the BS promote antagonistic effect, thus increase the CMC, which may be disadvantageous to lipolysis. *In vitro* lipolysis experiments showed a significant influence of the conjugated forms of BS, NaTC allowed for a faster rate of release of FFA as compared to the same concentration of the unconjugated counterpart NaDC. The results demonstrate the importance of the role of the BS in the lipid digestion process, which may uncover a potential for controlling the lipolysis process.

P-05 Bioaccessibility and Intestinal-Epithelial Transport of Bread-Melanoidins Extracted with10 kDa Polyethersulfone Membrane

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University of Burgos, Spain

Abstract:

Melanoidins are compounds generated in the late stages of the Maillard reaction from reducing sugars and proteins or amino acids during food processing and preservation. In the last decades the effects of melanoidins on human health and the beneficial components have gained a lot attention. The aim of this study was evaluated the bioaccesibility and intestinal transport efficiency of melanoidins extract obtained from bread crust. A concentrated melanoidins was recovered through the dead-end ultrafiltration of the extract using 10 kDa membrane with 76mm of diameter in polyethersulfone material. The bioaccesible fraction was obtained by gastrointestinal digestion and colonic fermentation. The samples were characterized by browning and UV-visible spectra and assessed for antioxidant properties and epithelial-intestinal transport was assayed across Caco-2 monolayers. The bioaccesibility and transport efficiency, measured by browning index, of colonic fermentation fraction were higher than gastrointestinal fraction. The antioxidant capacity of melanoidins extracts measured by FRAP method after intestinal transport were also higher in colonic fermentation. These results highlight bread derived melanoidins as potential ingredient functional.
The authors acknowledge financial support from Autonomous Government of Castilla y León and FEDER (JCyL/FEDER) BU243P18.

P-06 Chitosan-WPI Electrostatic Complex as a Nanocontainer for Essential Lipids

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Abstract:

Nowadays chitosan is of great interest in the molecular design of the delivery systems for nutraceuticals, based on food-grade biopolymers, owing to its unique properties, as a cationic polysaccharide (pKa = 6.3-6.5), and, as a biopolymer, having the mucoadhesive activity in the gastrointestinal tract, that can increase the absorption of the nutraceuticals. In this study we have focused on the ability of the electrostatic complex between chitosan (CHI: Sigma, Mw = 50–190 kDa, deacetylation > 75%) and whey protein isolate (WPI:Unflavored BiPro, Davisco Food International, USA) to behave as a nanocontainer for essential lipids, in particular omega-3 and omega-6 polyunsaturated fatty acids (PUFAs). In our work these lipids included soybean phosphatidylcholine liposomes (PC: Lipoid S-100), originally rich in omega-6 linoleic fatty acid (LA), enriched by omega-3 α-linolenic fatty acid (ALA) to an equimass ratio with LA. The CHI–WPI–(PC–ALA) complex was nanoscale. In such complex, the essential lipids acquired the solubility in an aqueous medium inherent in food biopolymers. In addition, the chosen food biopolymers protected PUFAs from oxidation in their complex. Moreover, this complex showed foaming capacity, which exceeded that of the protein alone. The use of multiangle laser light scattering (in the static, dynamic and electroforetic modes), differential scanning calorimetry and electron paramagnetic resonance spectroscopy allowed us to reveal the basic reletionships between the structure of the CHI–WPI–(PC–ALA) complex and its functionality. The studied complex can be suggested as an innovative food ingredient for functional food stuff. This work was financially supported by the Russian Science Foundation (Grant 21-16-00085).

P-07 High-Power Ultrasound for the Efficient Extraction of Pectin Fractions from Discarded Carrots (Daucus carota) and Eggplant (Solanum melongena) Fruit Exocarp

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Abstract:

As an advanced valorization strategy, agro-industrial by-products can be utilized for the extraction of valuable components such as pectins, contributing to sustainability. Pectins are complex polysaccharides of the plant cell-walls with functional properties of technological interest to the food and pharmaceutical industries. We efficiently obtained pectins from the dried and milled tissues of discarded carrots (CP) and eggplant exocarp (EP) through the application of environmentally friendly high-power-ultrasound (HPUS) (9.32 W/cm2 power intensity) in water, as a pretreatment before stirring in 0.1 M Na2CO3 for 1 h (23°C). This mild alkaline step extracts all cell-wall pectins including those anchored by esterification. A 5g:200mL proportion of CP or EP to water was used for HPUS (VCX 750, Sonics Materials Inc., USA: 20kHz, 80% amplitude, 20 min net time). The pectin yields obtained from CP and EP were 23% and 17.1%, respectively, without HPUS, whereas yields increased up to 35.4% for CP and 29.6% for EP with the HPUS pretreatment. In the latter case, 100% of the pectin (uronic acids, UA) content of CP (14% w/w) and 93.3% of that of EP (23.9% w/w) were extracted, demonstrating the high efficiency of the process due to the previous disruption of CP and EP cell-walls by HPUS. The pectin fractions obtained either without or with HPUS from CP and EP had 40% and 75.4% of UA, respectively, with very low degree of methyl esterification. Dynamic mechanical spectra of 2.0% w/v aqueous solutions with Ca2+ (20 mg/100g UA) revealed “true gels”.

P-08 Effect of Addition of Amaranth Seed and Sprout Flours on Tilapia Minced Restructured

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Abstract:

Tilapia *(Orechromis niloticus)* is a worldwide popular cultured freshwater fish, accepted for its high nutritional value, rapid growth, easy cultivation and low price. Tilapia meat can be used to make restructured products. The demand of healthy food products from consumers all over the world has motived the fishery industry to developed high functional meat products. Amaranth seed and sprout flour are source rich in dietary fiber and polyphenols that can be used for the fortification with bioactive compounds of protein-rich fish products. Therefore, we make restructured tilapia meat products added with amaranth seed and sprout flour to improve the functional and physicochemical properties of restructured tilapia products. When 6-8% of amaranth seed flour was added the TPA parameters of hardness (36.7 N), cohesiveness (0.40), springiness (0.95) and chewiness (14.0) values were improve compared to the control and amaranth sprout flour. The addition of amaranth seed and sprout flour were found to influence the moisture, protein, lipid content as well has the colorimetric parameter. Tilapia restructured added with amaranth sprout flour increase the content of betanidine, isobetanidine, keampferol rutinoside, keampferol dihexoside and vanillic acid compared to the control treatment and amaranth seed flour. Hence, we demonstrated that it is feasible to prepare restructured Tilapia meat products add with a functional ingredient as amaranth seed or sprout flour, which offers a means of using muscle by-products and exploiting new functional products with an added commercial value.

P-09 The Impact of Environment on Micro and Macronutrients in Meat

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Abstract:

This project focuses on the investigation and analysis of general characteristics of meat. The nutritional profile of chicken, beef, pork, etc. have been investigated by hundreds of researchers previously, to define concentration of proteins, fats, vitamins, minerals and carotenoids to name only a small portion of the analytes tested. Since meat is a product of animals, its nutritional value depends on factors such as environment (i.e., soil composition), animal feed and animal genetics. This project's goal is to determine how these factors affect meat's nutritional profile and how meat industry's distribution and promotion of certain meat products and claims, survive analysis. Price variations have been observed for different retail meat products i.e., organic VS free range VS standard meat. Higher prices are based on meat properties such as: absence of antibiotics and hormones in animals' diet, pasture-raised livestock and high concentrations of beneficial nutrients. However, a remaining question is whether those prices observed in the market are truly reflecting those beneficial properties and if the differences between meat attributes are significant. Since consumers spend a significantly larger amount of money to obtain better quality meat, it is important to investigate what actions take place in meat industry to ensure the delivery of that quality to customers. It is also significant to verify the nutritional value of different meat types-products corresponding to a different price range. This can be possible by developing a nutritional profile that will help us distinguish the differences between meat categories such as Organic or free range.

P-10 Predicting Functional Properties of Whey with Front-Face Fluorescence of Tryptophan

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Abstract:

Interest in whey is increasing due to its functional properties, so a rapid evaluation technique is demanded. Previous study revealed several significant correlations between fluorescence of tryptophan (Trp) and its functional properties. Thus, the present objective was to generate models for predicting foaming, gel-forming and emulsification capacities. Whey was obtained through isoelectric precipitation of caseins from reconstituted skim milk powder (12%) enriched with whey protein isolate (5%) and treated at different heat loads. Foaming, i.e., overrun and drainage, was assessed by whipping samples with a mixer. Gel-forming index was calculated with the weight of gel formed (90 °C, 1 h). 25% oil emulsions were assessed with the emulsifying activity (EAI) and bottom turbiscan stability indexes. For each parameter, two predictive models were obtained since Trp front-face fluorescence (exc. 290 nm, em. 300-450 nm) had two variables (maximum intensity and its corresponding wavelength). All one-variable models had intensity as predictor, and wavelength on the two-variable models was not significant. The best model was obtained for EAI (R2 = 0.90, SEP = 0.20 m2 g-1). The rest of models had R2 between 0.55 and 0.80. Validation was carried out on models with one variable. In conclusion, surprisingly, Trp fluorescence of whey had enough information to build a strong model for one of indexes evaluating the emulsification capacity. The combination with other fluorescent markers would be necessary for predicting the rest of functional properties evaluated.

P-11 Morphological, Organoleptic and Sensory Characterization of Almond Cultivars

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Abstract:

Almond is an important fruit crop species worldwide cultivated for it's appreciate kernel for both processed food industry and as a functional food with medical (nutraceutical) properties including nutrients, vitamins, healthy blood lipids or anti-inflammatory and hypocholesterolemic properties. To determine the fruit quality of modern and traditional almond cultivars in different growing conditions (dry and irrigation), a morphological, organoleptic and sensory characterization was carried out. Samples from 15 Spanish almond cultivars, five American, two of French origin and one Italian cultivar were collected to perform this study. Leave samples were collected from each cultivar to confirm their genotype. Clear morphological differences were observed between the fruits of the genotypes, mainly due to the 'hardness of the shell', being Spanish cultivars harder than the other. Regarding sensorial characterization, through a panel of experts trained by IRTA, several attributes seem to contribute to the differentiation between cultivars, such as 'crocanticity' and 'sweetness'. American genotypes seem to have a different pattern in term of both attributes than the rest of the cultivars. Near infrared spectroscopy (NIRS) was used to estimate the nutritional values of nuts. In general, high content of proteins, fiber and fat were observed in these almond cultivars. Some of the Spanish traditional cultivars, from Region of Murcia, such as "Colorada" and "Peraleja" showed high values of protein and fats, respectively. In addition, the content of phytosterols or plant sterols, such as β-sitosterol, was high in the selected crops. In general, growing conditions seem not affect almond quality. The complete characterization of almonds clearly confirms the health benefits of almonds consumption.

P-12 Fish Processing with Honey for Taste Component Maintenance

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Abstract:

Inosinic acid (IMP) is the main taste component of fish generated during the degradation of ATP. However, IMP is also degraded by the IMP degrading enzyme (IMPase). Therefore, it is necessary to inhibit IMPase activity to maintain the taste component of fish. As fish deteriorates quickly, it must be processed quickly and stored. Sugar is often used for fish processing; sucrose, one of the main components of sugar, reportedly inhibits IMPase activity in grunt, yellowtail, and cod. As honey has high sugar and monosaccharide contents, it is expected to inhibit IMPase activity. Herein, we investigated the effects of honey and the monosaccharides in honey on IMPase activity in chub mackerel, which is consumed worldwide. In additive- and processing-free chub mackerel, we considered IMPase activity to be 100%. At 5% final honey concentration, IMPase activity was 13%, while at 1%, IMPase activity was 67%. At 4% final glucose and fructose final concentrations, IMPase activity was 48% and 6.6%, respectively, whereas at 0.8%, it was 73% and 65%, respectively. Moreover, at the final concentration of 1.9% glucose and 2.2% fructose, IMPase activity was 1.7%, whereas at the final concentration of 0.37% glucose and 0.45% fructose, it was 64%. Thus, we showed that IMPase activity decreased with the increasing concentrations of glucose, fructose and honey, confirming that sugar facilitates the inhibition of IMPase activity. However, as glucose imposes a weaker inhibitory effect than fructose, honey exhibits IMPase activity inhibition because of its higher fructose content.

P-13 Inhibition of Bacterial Tyrosine Phenol-Lyase by Sesame *(Sesamum indicum L.)* Lignans

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Abstract:

Diabetic kidney disease (DKD) is a major cause of end-stage renal and cardiovascular diseases and increases the risk of death. There is no specific medicine to treat DKD and therefore a breakthrough in prevention and treatment of DKD is urgently needed. Recently, phenyl sulfate was shown to contribute to albuminuria and serves as a major risk factor of DKD. Phenyl sulfate is derived from phenol in the liver, which is produced exclusively from dietary L-tyrosine by bacterial tyrosine phenol-lyase (TPL) in the human gut. Thus, inhibition of bacterial TPL in the gut may reduce the production of phenol and serve as a promising strategy to prevent or treat DKD. During the course of our screening program of bacterial TPL inhibitors, we found that sesame (Sesamum indicum L.) lignans, such as sesamin, sesaminol and sesamol, serve as specific inhibitors of TPL. For example, sesamin or sesaminol at 250 mM caused 97% inhibition of TPL activity. Kinetic studies revealed that these lignans act as uncompetitive inhibitors with Ki values of 70 mM (sesamin), 118 mM (sesaminol) and 194 mM (sesamol). Moreover, incubation of phenol-producing bacterial cells such as Citrobacter sp. with 5 mM sesamol inhibited the bacterial production of phenol from L-tyrosine. These results indicate that sesame lignans may serve as a dietary supplement to prevent DKD and provide a template for designing more potent TPL inhibitors to specifically treat DKD.

P-14 Analysis of Underivatized Amino Acids in Wines by Solid Phase Extraction and HILIC-MS

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Abstract:

Amino acids are the most important nitrogen source in wine production, accounting for 30% to 40% of the total wine nitrogen. The amino acid analysis in wine can be a challenging task due to possible interferences present in wine (such as organic acids, polyphenolic compounds, protein, lipid, and pigments). In this work, we report a new SPE-HILIC-MS method for analysis of 16 underivatized amino acids in wines. A SPE method was developed to remove hydrophobic matrix interferences (such as lipids, pigments and proteins) present in wines, prior to HILIC-

MS analysis. Briefly, the polar analytes (i.e., amino acids) were filtered and passed through a C18 SPE cartridge while hydrophobic wine components were retained on the SPE cartridges. We used a HILIC column to retain and separate polar amino acids without prior derivatization. The mass detection allowed the quantification of several co-eluting amino acids and the ion source parameters were optimized to determine all target amino acids in a test wine, with a focus on two amino acids (aspartic acid and glycine) showing poor signal response. All amino acids except three peak pairs (Ala/Hyp, Tyr/Val, Arg/His) were baseline-separated within 22 min, including the separation of isomers of Leu and Ile. All 17 amino acids were detected in all analyzed wines, with the exception of three amino acids (i.e., histidine, serine and valine in two red wines). The SPE method generally showed good area precision and recovery of spiked matrix.

P-15 The Microbial Interaction and Stability in Taiwanese Ropy Fermented Milk during Fermentation and Successive Subcultures

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Abstract:

Taiwanese ropy fermented milk (TRFM), a type of viscous fermented milk that predominantly involves slime-producing lactic acid bacteria, *Lactococcus lactis* subsp. *cremoris*, and yeast, *Kluyveromyces marxianus*. The composition of microorganism, texture, and flavor of TRFM are very similar to the traditional Finland fermented milk, Viili, which contains the mold, *Geotrichum candidum*, forming a velvet-like surface on the top of it. Since microbial interactions play an important modulatory role in this particular ecosystem during fermentation, thus, the purpose of this study was to clarify the interaction between the microorganisms in TRFM and Viili. The microbial count, physicochemical properties, metabolites production and texture analysis were analyzed when *L. lactis* subsp. *cremoris* co-cultured with *Klu. marxianus* and *G. candidum* in non-homogenized milk. The results showed that the presence of fungi could increase the viscosity and contribute to the structure of fermented milk without affecting the viability of LAB and exopolysaccharide production when culturing with fungi as compared to single culture. Besides, the stability of co-cultivation combinations during the successive subcultures uninterrupted or with 7-day or 14-day intervals was also investigated. Results indicated the *G. candidum* counts were significantly affected by fermentation and aging time, thus, the subculture process with 7-day or 14-day intervals were necessary to sustain the mold growth. Additionally, the physicochemical properties of fermented products were also significantly influenced by the types of subcultures. In conclusion, we provide an important knowledge related to the relationship of the three microorganisms in TRFM and Viili during fermentation, storage and subculture.

Citation: Proceedings of the Seventh International Conference on Food Chemistry & Technology (FCT-2021). *J Food Chem Nanotechnol* 7(Suppl 1): S1-S45.

Published by United Scientific Group.

Received: November 15, 2021 **Accepted:** November 18, 2021 **Published:** November 21, 2021